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WOODWARD-CLYDE CONSULTANTS PLYMOUTH MEETING PA  
NATIONAL DAM INSPECTION PROGRAM, BEAVER CREEK DAM (SCS PA 433).--ETC(U)  
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BEAVER CREEK, Chester County, Pennsylvania.

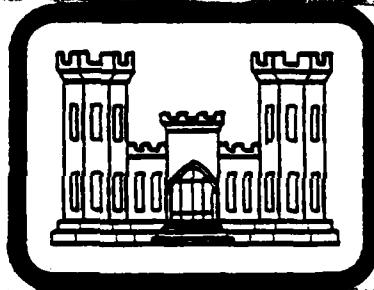
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BEAVER CREEK DAM  
(SCS PA 433).

CHESTER

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DER I.D. N<sup>o</sup> 15-301,  
NUMBER

PHASE I INSPECTION REPORT,  
NATIONAL DAM INSPECTION PROGRAM

⑩ Mary F. Beck  
John H. Frederick, Jr.



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⑯ DACW31-80-C-0018

Prepared by:

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5120 Butler Pike  
Plymouth Meeting, Pennsylvania 19462

Submitted to:

DEPARTMENT OF THE ARMY  
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David

PREFACE

→ This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams for Phase I Investigations. —Copies of these guidelines may be obtained from the Office of the Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation is to expeditiously identify those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigations, testing and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify the need for more detailed studies.

→ In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure. ←

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected, and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

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PHASE I INSPECTION REPORT  
NATIONAL DAM INSPECTION PROGRAM

Name of Dam:	Beaver Creek Dam (SCS PA 433)
County Located:	Chester County
State Located:	Pennsylvania
Stream:	Beaver Creek
Coordinates:	Latitude 40° 1.8' Longitude 75° 47.0'
Date of Inspection:	March 25, 1980

Beaver Creek Dam is owned by the Chester Water Resources Authority. The dam was built as part of a flood control plan consisting of six dams on the East Branch Brandywine Creek Watershed.

The dam and its appurtenant facilities are considered to be in good condition. The dam is classified as an "Intermediate" size structure with a "High" hazard classification, consistent with the dam's location above the communities of Bondsville, Fisherville and Downingtown.

In accordance with criteria established by Federal (OCE) Guidelines, the recommended spillway design flood for this "Intermediate" size dam and "High" hazard classification is the Probable Maximum Flood (PMF). The Soil Conservation Service designed this dam as a Class C structure, which also requires that the spillway systems be designed to pass the PMF. The original flood routing is included in Appendix D, and the spillway classification for this structure is considered to be "Adequate".

It is recommended that the following measures be undertaken as soon practical.

1. Future erosion at the junction of the embankment and right abutment should be prevented by the use of graded rock and bedding material.
2. Debris should be removed periodically from the intake channel immediately upstream of the riser pond drain invert orifice.
3. The pond drain gate should be made operational.

BEAVER CREEK DAM, NDS I.D. NO. PA 00903

Because of the location of the dam upstream of Bondsville, Fisherville and Downingtown, a formal procedure of observation and warning during periods of high precipitation is being developed. It is reported that this warning procedure will include monitoring of the dam during periods of high precipitation and a method of warning and evacuating downstream residents along the creek, if necessary.

Access to the dam is through Fernvue Farms from the left abutment, which requires crossing the emergency spillway, which may be flooded during an emergency. Direct access to the dam is provided through a locked gate in a chain link fence at the right abutment of the dam. The Chester Water Resources Authority presently does not have a key to the gate. Therefore, it is suggested that Chester Water Resources Authority be provided a key to the gate.

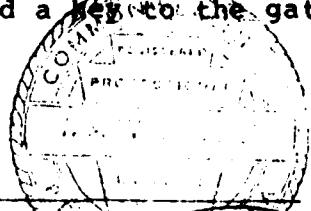
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Date



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*4/29/80*

Date



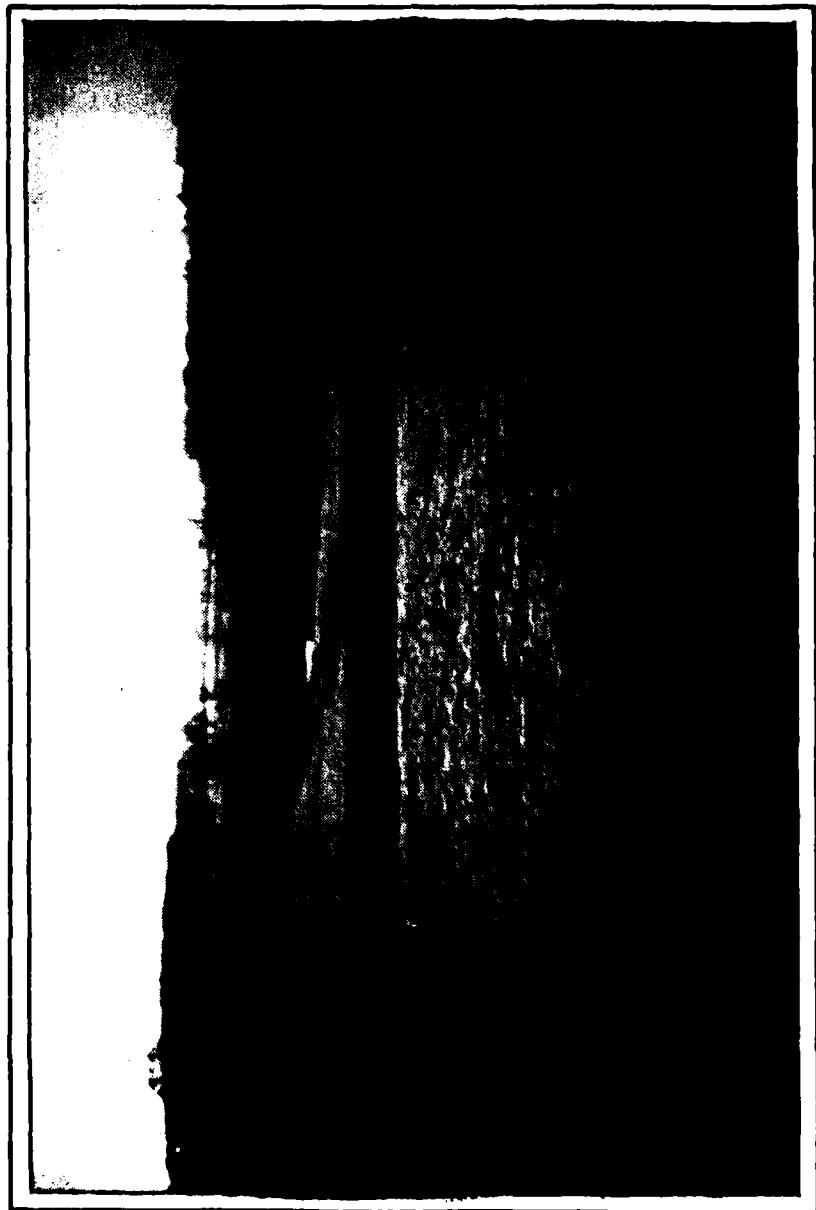
APPROVED BY:

*James W. Peck*

JAMES W. PECK  
Colonel, Corps of Engineers  
District Engineer

*21 May 80*

Date



OVERVIEW  
BEAVER CREEK DAM (SCS PA 433), CHESTER COUNTY, PENNSYLVANIA

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PHASE I INSPECTION REPORT  
NATIONAL DAM INSPECTION PROGRAM  
BEAVER CREEK DAM  
(SCS PA 433)  
NATIONAL ID #PA 00903  
DER #15-301

SECTION 1  
PROJECT INFORMATION

1.1 General.

a. Authority. The Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.

b. Purpose. The purpose of the inspection is to determine if the dam constitutes a hazard to human life or property.

1.2 Description of Project.

a. Dam and Appurtenances. Beaver Creek Dam is a zoned earth embankment with a relatively impervious cutoff trench beneath the embankment centerline. A typical plan and section of the dam are shown on Plates 3 and 4, Appendix E. The dam is approximately 1,400 feet long and the height, measured from the relocated stream bed at the downstream toe to the crest, is about 36 feet. Embankment fill was obtained from within the reservoir and from the emergency spillway excavation. Zone 1 materials, classified as low plasticity clays and silts, were used as impervious fill in the core trench, as an upstream section and as a blanket under the upstream half of the dam; see Plate 4, Appendix E. Zone 2 materials, classified as silty sands, form the bulk of the embankment. The cutoff trench is 12 feet wide at the bottom and has side slopes of 2H:1V. About one-third of the way from the downstream toe to the dam centerline is a drain trench. Seepage intercepted by the drain trench is collected in a perforated drain pipe and discharged through the side walls of the impact basin at the downstream toe. The downstream slope is 3H:1V and the upstream slope is also 3H:1V with a 10 foot wide berm at approximately elevation 487.1, the design normal/sediment pool elevation. The crest is 14 feet wide with a design settled fill elevation of 510.8. A gravel road crosses the emergency spillway and dam breast, as shown on Plate 3.

The principal spillway, located at centerline Station 16 + 50, is composed of a single-stage drop inlet riser located at the upstream toe of the embankment, a 208 foot long, 30 inch diameter reinforced concrete pressure pipe, and an impact basin at the downstream toe. The crest of the riser weirs is at elevation 486.6, and the conduit outlet invert and impact basin end sill elevation is 474.5. The pond drain, a two foot diameter orifice at elevation 477.5, is gated on the outside, or upstream side, of the riser. The discharge conduit has seven reinforced concrete anti-seepage collars, located as shown on Plate 8, Appendix E.

The emergency spillway is at the left abutment. The grass lined emergency spillway channel is 225 feet wide, with a 30 foot long level section at elevation 504.8. The emergency spillway side slopes are both 3H:1V. The emergency spillway is excavated through earth, and the maximum discharge slope is three percent. Flow from the emergency spillway joins with principal spillway discharge about 700 feet below the dam.

b. Location. The dam is located on Beaver Creek in East Brandywine Township, Chester County, Pennsylvania. The dam site is located approximately 3.4 miles northwest of the intersection of U.S. Routes 322 and 30. The dam site and reservoir are shown on USGS Quadrangle entitled "Wagontown, Pennsylvania" at coordinates N 40° 1.8' W 75° 47.0'. A regional location plan of Beaver Creek Dam is enclosed as Plate 1, Appendix E.

c. Size Classification. The dam is classified as an "Intermediate" size dam by virtue of its 36 foot height and 1,468 acre-feet total storage capacity.

d. Hazard Classification. A "High" hazard classification is assigned consistent with the potential for extensive property damage and possible loss of life downstream along Beaver Creek.

e. Ownership. The dam is located on land leased from Fairvue Farms by Chester Water Resources Authority. All correspondence should be sent to Mr. David C. Yaeck, Executive Director, Chester Water Resources Authority, Room 314, F & M Building, High & Market Streets, West Chester, Pennsylvania 19380.

f. Purpose of Dam. The purpose of this dam is for flood control. Beaver Creek Dam is one of six proposed or constructed flood control structures located within the East Branch Brandywine Creek Watershed.

g. Design and Construction History. Beaver Creek Dam was constructed as a flood retarding structure under the provisions of the Watershed Protection and Flood Prevention Act. The Soil Conservation Service (SCS) designed the dam and provided resident engineering and construction inspection services. Construction began in the June 1974. The dam was completed in October 1975, and final inspection was scheduled for November 13, 1975. In January 1976, the pond drain gate was closed.

The SCS project engineer was Mr. Frederick H. Schuetz, who submitted bimonthly construction progress reports to the state in addition to detailed construction records kept by SCS. Construction summary records located in Department of Environmental Resources (DER) files indicate that embankment materials were placed in accordance with specifications. Specifically, all embankment density tests met or exceeded the minimum specified 95 percent of the Standard Proctor Maximum Dry Density (ASTM D 698).

Land for this dam was leased to the Water Authority rather than sold for fee simple because the Owner wanted to prevent public access to the reservoir. In July 1976, application was made and permission received to open the pond drain gate and convert the structure to a dry dam.

h. Normal Operating Procedures. Under normal operating conditions, the pond drain gate is open, and water flows through the pond drain orifice and through the principal spillway conduit. During a large storm event, excess water would be stored to elevation 486.6, the riser weirs elevation, and thereafter stored to elevation 504.8, when water would be discharged through the emergency spillway at the left abutment.

### 1.3 Pertinent Data.

A summary of pertinent data for Beaver Creek Dam is presented as follows.

a.	Drainage Area (square miles)	3.1
b.	Discharge at Dam Site (cfs)	
	Maximum Known Flood at Site	Unknown
	At Design High Water	1,225
	At Top of Dam	9,410
c.	Elevation (feet above MSL)	
	Top of Dam	510.8

Design High Water	506.6
Emergency Spillway Crest	504.8
Principal Spillway	
Weir Crest	486.6
Pond Drain Inlet Invert	477.5
Outlet Invert	474.5
Downstream Toe (low point)	480.3
Stream at Downstream Toe	474.5
d. Reservoir (feet)	
Length at Normal Pool	Dry
Length at Design High Water	3,750
e. Storage (acre-feet)	
Sediment Storage	43
To Emergency Spillway Crest	843
To Top of Dam	1,464
f. Reservoir Surface (acres)	
Normal Pool	Dry
Sediment Pool	11
At Top of Dam	120
g. Dam Data	
Type	Zoned earth
Volume	106,000 cubic yards
Length	1,370 feet
Maximum Height *	36 feet
Top Width	14 feet
Side Slopes	
Upstream	3H:1V
Downstream	3H:1V
Cutoff	Cutoff trench under dam centerline
Grout Curtain	None
h. Principal Spillway	
Type	Single stage reinforced concrete drop inlet riser, 30 inch conduit and impact basin at downstream toe

---

\* Measured from dam crest to the relocated stream bed at the downstream toe.

Reservoir Drain	24 inch orifice in riser
Elevations (feet)	
Weirs	486.6
Pond Drain Inlet Invert	477.5
Conduit Outlet Invert and	
Impact Basin End Sill	474.5
Energy Dissipator	Impact basin at downstream toe
i. Emergency Spillway	
Type	Grass lined trape- zoidal channel exca- vated through earth
Width	225 feet
Side Slopes	3H:1V

## SECTION 2 ENGINEERING DATA

### 2.1 Design.

a. Data Available. A summary of engineering data for Beaver Creek Dam is attached as Appendix B. Engineering data available for review is contained in a several hundred page design folder prepared by the United States Department of Agriculture, Soil Conservation Service (SCS), and a 33-page set of as-built drawings from the Department of Environmental Resources (DER) files. These drawings were prepared by the SCS. Other documentation included miscellaneous letters, correspondence and bimonthly construction reports prepared by the SCS resident engineer.

b. Design Features. Principal design features of Beaver Creek Dam are illustrated on the plans and profiles enclosed in Appendix E as Plates 2 through 8. These plates were reproduced from the as-built drawings. A detailed description of the design features is also presented in Section 1.2, paragraph a, and pertinent data relative to the structure is presented in Section 1.3.

### 2.2 Construction.

Known details of construction are presented in Section 1.2, paragraph g. Construction records reviewed for this project were obtained from DER files located in Harrisburg, Pennsylvania.

### 2.3 Operational Data.

There are no operational records maintained.

### 2.4 Evaluation.

a. Availability. All engineering data evaluated and reproduced for this report were provided by the Pennsylvania DER or by SCS.

b. Adequacy. The data included in the state files, supplemented with data obtained from the Owner, are considered adequate to evaluate the dam and appurtenant structures.

c. Validity. There is no reason to question the validity of this data.

SECTION 3  
VISUAL INSPECTION

3.1 Findings.

a. General. Observations and comments of the field inspection team are contained in the checklist enclosed herein as Appendix A, and are summarized and evaluated as follows. In general, the dam and its appurtenant structures are considered to be in good condition. At the time of the inspection (March 25, 1980), stream flow was passing through the principal spillway, and the reservoir level was above normal because of a previous rainfall, preventing access to the riser. On April 25, the reservoir level was down, permitting access to the riser.

b. Dam. During the visual inspection, there were no indications of distortion in alignment or grade that would be indicative of movement of the embankment or foundation. Crownvetch cover on both the upstream and downstream slopes, although dormant, is considered to be in good condition. A minor amount of first year weedy vegetation was noted. The upstream embankment below the berm was soft and had a small amount of rainwater standing on it. The dam crest was in good condition, with no standing rainwater. No erosion gullies were noted on either the upstream or downstream embankments, or over the edge of the crest. Rainwater was standing in the area beyond the downstream toe of the embankment, which is flat.

The vertical/horizontal alignments were checked and found to be in satisfactory condition across the emergency spillway control section and along the dam crest. The vertical alignment is shown on sheet 5B, Appendix A. The upstream junction of the right abutment and embankment is in good condition, with no paths or erosion noted. A diversion channel is constructed about one-third of the distance down from the top of the dam at the downstream junction of the embankment and right abutment to divert surface runoff away from the toe of the dam. A gully is starting to form in the junction below this diversion, with a scarp about 4 or 5 inches high. The junctions between the embankment and left abutment appear to be in good condition, although paths have been worn through the vegetation. The depth of the water in the impact basin was above the invert of the embankment drain outlets, preventing determination of whether the embankment drains were flowing. The second visit to the site indicated that the water level in the impact basin is normally above the embankment drain inverts.

c. Appurtenant Structures.

1. Principal Spillway. The riser is located at the upstream toe of the embankment. Exposed portions of the riser were inspected and evaluated to be in good condition with no signs of excessive concrete deterioration, spalling or other structural deficiencies or defects. The trash rack channels were bent by ice during the winter of 1977-1978. Debris was noted in the water around the riser, and should be removed during routine maintenance. The interior of the intake riser was inspected and the pond drain gate was exercised during the second visit to the site. The pond drain gate was closed and could not be opened, impounding water. The Soil Conservation Service is providing the Owner with information to order replacement parts for repair.

The exposed portions of the impact basin were inspected and found to be in good condition. The outlet channel was inspected and observed to be in good condition with no excessive erosion or bank undercutting.

2. Emergency Spillway. The hay lined emergency spillway at the left abutment was inspected and found to be stable and in good condition. The side slopes are well vegetated and appear to be in good condition. The outside spillway slope has an occasional area of gravel at the surface, with no vegetation over it. The channel bottom is densely vegetated. At the time of the inspection, it appeared that a piece of farm equipment had been moved through the emergency spillway adjacent to the outside wall, making cuts through the vegetation and root mass. Farm equipment should not be permitted to damage the emergency spillway.

d. Reservoir. At the time of the inspection, the water level was about five feet above the pond drain invert. The permanent pool area had previously been cleared of all vegetation, but when the dam was converted to a dry structure, the permanent pool area was allowed to go back to natural vegetation. Above the permanent pool area, the reservoir side slopes are moderate and vegetated with grass and trees. Some debris was noted along the shoreline, which could partially block flow through the principal spillway.

e. Downstream Channel. As shown on Plate 1, Appendix E, Beaver Creek flows in a southeast direction, and enters the East Branch Brandywine Creek above Downingtown, about six miles below the dam. About two river miles below the dam is the small village of Bondsville. At Bondsville, Beaver Creek enters a small pond formed by a dam. Between Beaver Creek Dam and Bondsville are four or five houses which would be damaged

in the event of failure. At Bondsville, additional homes and a factory, presently unoccupied, would be damaged in the event of failure. Farther downstream in Fisherville are at least five more homes subject to damage in the event of failure. The Brandywine Creek Watershed Work Plan identifies Bondsville and Downingtown as areas benefited by construction of Beaver Creek Dam. This clearly justifies a "High" hazard classification.

### 3.2 Evaluation.

Inspection of the dam and appurtenant facilities disclosed no evidence of apparent past or present movement that would indicate existing instability of the dam, principal or emergency spillways. Exterior and interior portions of the principal spillway were inspected and observed to be in good condition. The pond drain gate is presently inoperable and should be repaired. The principal spillway discharge channel is in good condition with no excessive bank undercutting or erosion. The emergency spillway channel and area below the dam were observed to be in good condition. The reservoir shoreline contains some debris which could float and partially clog the principal spillway. The crest of the dam is in good condition with no wet or poorly drained areas. The upstream and downstream slopes are well vegetated with Crownvetch and judged to be in good condition.

Although the erosion between the downstream embankment and right abutment is still fairly minor in nature, it is recommended that graded rock and bedding material be installed to prevent further damage.

## SECTION 4 OPERATIONAL PROCEDURES

### 4.1 Procedures.

Operational procedures are discussed in Section 1.2. Operation of the dam does not require a dam tender. Under normal conditions, flow discharges through the pond drain orifice and through the 30 inch reinforced concrete conduit at the base of the embankment. Excess water is stored first to the riser weir elevation and then to the crest of the emergency spillway. According to the Owner's representative, water has never flowed over the emergency spillway. There are written operation and maintenance procedures for this structure.

### 4.2 Maintenance of the Dam.

Fernvue Farms is under contract to the Chester Water Resources Authority to provide maintenance for the embankment and emergency spillway.

### 4.3 Maintenance of Operating Facilities.

Maintenance of these facilities includes cleaning debris from the intake systems and exercising and lubricating the pond drain gate. Maintenance is provided by employees of Chester Water Resources Authority.

### 4.4 Warning Systems In Effect.

The executive director of Chester Water Resources Authority indicated that a warning system is being developed for the entire Chester County as part of the National Weather Service flood warning network. Evacuation procedures are being developed for downstream residences in the event of an emergency.

### 4.5 Evaluation.

It is judged that the current operating procedure, which does not require a dam tender, is a realistic means of operating the relatively simple control facilities at Beaver Creek Dam.

Direct access to the dam is prevented by a locked gate in a chain link fence at the right abutment of the dam. The Chester Water Resources Authority presently does not have a key to the gate. Access to the dam is through Fernvue Farms from the left abutment, which requires crossing the emergency spillway, which may be flooded during an emergency. Therefore, it is suggested that Chester Water Resources Authority be provided a key to the gate.

## SECTION 5 HYDROLOGY/HYDRAULICS

### 5.1 Evaluation of Features.

a. Design Data. The complete folder of SCS design calculations was reviewed, and portions of this folder are presented in Appendix D.

The watershed is about 2.6 miles long and averages one mile wide, having a total area of approximately 3.1 square miles. Elevations range from 760 in the upper reaches to 477.5 at the pond drain elevation. The watershed is predominantly open/farmland with less than five percent residential development. Residential development can be expected to continue slowly within the watershed.

In accordance with criteria established by Federal (OCE) Guidelines, the recommended spillway design flood for this "Intermediate" size dam and "High" hazard classification is the Probable Maximum Flood (PMF). The Soil Conservation Service designed this dam as a Class C structure, which also requires that the spillway systems be designed to pass the PMF.

b. Experience Data. There are no records of reservoir levels kept for this dam. While rainfalls are not measured within the Beaver Creek Watershed, rainfall measurements are maintained within the Brandywine Creek Watershed as part of the National Weather Service's national flood warning network. There are no estimates or records of previous high water levels beyond a minimum high water elevation of 491+, the top of the riser slab.

c. Visual Observations. On the date of the inspection, there were no conditions observed that would indicate a reduced spillway capacity during an extreme event other than an accumulation of debris in the water upstream of the riser. Observations regarding the condition of the downstream channel, spillways and reservoir are located in Appendix A and discussed in greater detail in Section 3.

d. Overtopping Potential. The dam was designed to pass the PMF without overtopping. The PMF inflow hydrograph and flood routing are presented in Appendix D. This information was reviewed, evaluated and judged to be adequate. In summary, the peak inflow was computed as 11,761 cfs resulting from a six-hour storm with 26.0 inches of rainfall, producing

21.8 inches of runoff. The storm was routed through the reservoir to produce a peak discharge of 9,160 cfs and a maximum water level elevation of 510.7 just below the top of the dam. Spillway systems for this dam are considered to be "Adequate" as the dam will pass the PMF without overtopping.

e. Downstream Conditions. Beaver Creek Dam is one of six planned or constructed flood control structures on the East Branch Brandywine Creek. The combined effect of the structures is estimated (by the Watershed Work Plan) to reduce flooding in Downingtown resulting from a 100 year event from seven feet above flood stage to two feet. In addition to providing relief from flooding in Downingtown, Beaver Creek Dam affords protection to the areas of Bondsville and Fisherville, located along Beaver Creek above Downingtown. There are about ten homes built near Beaver Creek subject to damage in the event of a dam failure, justifying a "High" hazard classification.

## SECTION 6 STRUCTURAL STABILITY

### 6.1 Evaluation of Structural Stability.

a. Visual Observations. Visual observations detected no evidence of existing or impending embankment instability. Upstream and downstream slopes appear stable, with no surficial slides or other indications of deep-seated instability. Both the upstream and downstream slopes are well vegetated with Crownvetch and appear to be in good condition. There were no exterior signs or other evidence to indicate that the internal drainage system was not operating properly. It is noted, however, that during this inspection, the embankment was not retaining a significant head of water, which could affect the internal drainage system, and it is also noted that, at the time of the inspection, the tailwater in the impact basin was higher than the discharge invert elevation of the embankment drains.

Wet areas and standing rainwater were observed on the upstream embankment below the berm and downstream beyond the toe of the dam.

Exposed portions of the principal spillway were inspected and judged to be in good condition. The emergency spillway was also inspected and assessed to be in good condition.

b. Design and Construction Data. Design documentation is very complete and a several hundred page design folder prepared by the Soil Conservation Service (SCS) was reviewed for this investigation. Data included in these files are a foundation report containing permeability test results, shear strength test results and a stability analysis, structural calculations for the principal spillway and a complete set of hydrologic/hydraulic calculations. Portions of the hydrologic/hydraulic section are presented in Appendix D. Principal features of this structure are presented on the drawings located in Appendix E. Also included in the design folder are a complete set of specifications and an estimate of the quantity of materials used in the embankment.

Stability analyses were performed by SCS using the Swedish circle method and the wedge method. The conditions analyzed included rapid drawdown from elevation 501.7 on the upstream slope and steady seepage without embankment drainage on the downstream slope. The soil strength parameters were

determined from a direct shear test and a consolidated-undrained triaxial compression test on undisturbed samples of foundation soils and one triaxial test on compacted embankment soil. The upstream slope was assumed to be 3H:1V and the downstream slope 2.5H:1V. The maximum embankment height was assumed to be 33.8 feet.

The minimum factors of safety computed in the stability analyses were 1.69 for the upstream slope and 1.49 for the downstream slope. According to Corps of Engineers criteria, EM 1110-2-1902, these values are acceptable. The maximum height of the dam considered is somewhat less than the actual maximum height. However, since the dam was constructed with a 3H:1V downstream slope containing embankment drains, and since the elevation of the steady pool with the pond drain closed is only 486.6, it is assessed that the stability of the dam is adequate.

c. Operating Records. There are no operational records for this structure.

d. Post-Construction Changes. There are no reports nor is there any evidence that modifications were made to this dam.

e. Seismic Stability. The dam is located in Seismic Zone 1. Normally it can be considered that if a dam in this zone is stable under static loading conditions, it can be assumed safe for any expected earthquake conditions. As the dam is assessed to be stable under static loading conditions, it can reasonably be assumed to be stable under seismic loading conditions.

## SECTION 7 ASSESSMENT/REMEDIAL MEASURES

### 7.1 Dam Assessment.

a. Evaluation. Visual inspection and review of design and construction documentation indicate that the dam, foundation and appurtenant structures of Beaver Creek Dam are in good condition.

In accordance with criteria established by Federal (OCE) Guidelines, the recommended spillway design flood for this "Intermediate" size dam and "High" hazard classification is the Probable Maximum Flood (PMF). The Soil Conservation Service designed this dam as a Class C structure, which also requires that the spillway systems be designed to pass the PMF.

Hydrologic and hydraulic computations presented in Appendix D indicate the structure will pass the Probable Maximum Flood without overtopping. Therefore, the spillway systems of this structure are considered to be "Adequate".

b. Adequacy of Information. Information available for this investigation was sufficiently adequate to evaluate the structure and hydraulic aspects of the dam.

c. Urgency. It is recommended that suggestions presented in Section 7.2 be implemented as specified.

### 7.2 Remedial Measures.

a. Facilities. It is recommended that the following steps be taken as soon as practical.

1. Future erosion at the junction of the embankment and right abutment should be prevented by the use of graded rock and bedding material.
2. Debris should be removed periodically from the intake channel immediately upstream of the riser pond drain invert orifice.
3. The pond drain gate should be made operational.

b. Operation and Maintenance Procedures. Chester Water Resources Authority has a written operation and maintenance manual for this dam. A county wide written warning procedure is being developed. It is reported that this warning procedure will include monitoring of the dam during periods of high precipitation and a method of warning and evacuating residents downstream along the creek, if necessary.

Direct access to the dam is provided through a locked gate in a chain link fence at the right abutment of the dam. The Chester Water Resources Authority presently does not have a key to the gate. Access to the dam is through Fernvue Farms from the left abutment, which requires crossing the emergency spillway, which may be flooded during an emergency. Therefore, it is suggested that Chester Water Resources Authority be provided a key to the gate.

**APPENDIX**

**A**

CHECK LIST  
VISUAL INSPECTION  
PHASE 1

Sheet 1 of 11

Name Dam	<u>Beaver Creek Dam</u>	County	<u>Chester</u>	State	<u>Pennsylvania</u>	National
Type of Dam	<u>Earth</u>	Hazard Category	<u>High</u>	ID #	<u>PA 00903</u>	
Date(s) Inspection	<u>3/25/80</u>	Weather	<u>Cloudy</u>	Temperature	<u>30's</u>	

Pool Elevation at Time of Inspection 482.7 M.S.L. Tailwater at Time of Inspection N/A M.S.L.

Inspection Personnel:

<u>Mary F. Beck (Hydrologist)</u>	<u>Vincent McKeever (Hydrologist)</u>
<u>Arthur H. Drinoff (Geotechnical)</u>	<u>John H. Frederick, (Geotechnical)</u>
<u>Raymond Lambert (Geologist)</u>	<u>(4/8/1980)</u>

Mary F. Beck Recorder

Remarks:

Mr. David Yaack, Executive Director of Chester Water Resources Authority was on site and provided assistance to the inspection team. Mr. Gary Emmanuel, D.E.R. Norristown, also accompanied the inspection team. 4/18/80. Mr. Elbert Wells, SCS District Conservationist, was on site to operate pond drain gate.

CONCRETE/MASONRY DAMS

Sheet 2 of 11

<u>VISUAL EXAMINATION OF</u>	<u>OBSERVATIONS</u>	<u>REMARKS OR RECOMMENDATIONS</u>
ANY NOTICEABLE SEEPAGE	N/A	
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	N/A	
DRAINS	N/A	
WATER PASSAGES	N/A	
FOUNDATION	N/A	

CONCRETE/MASONRY DAMS

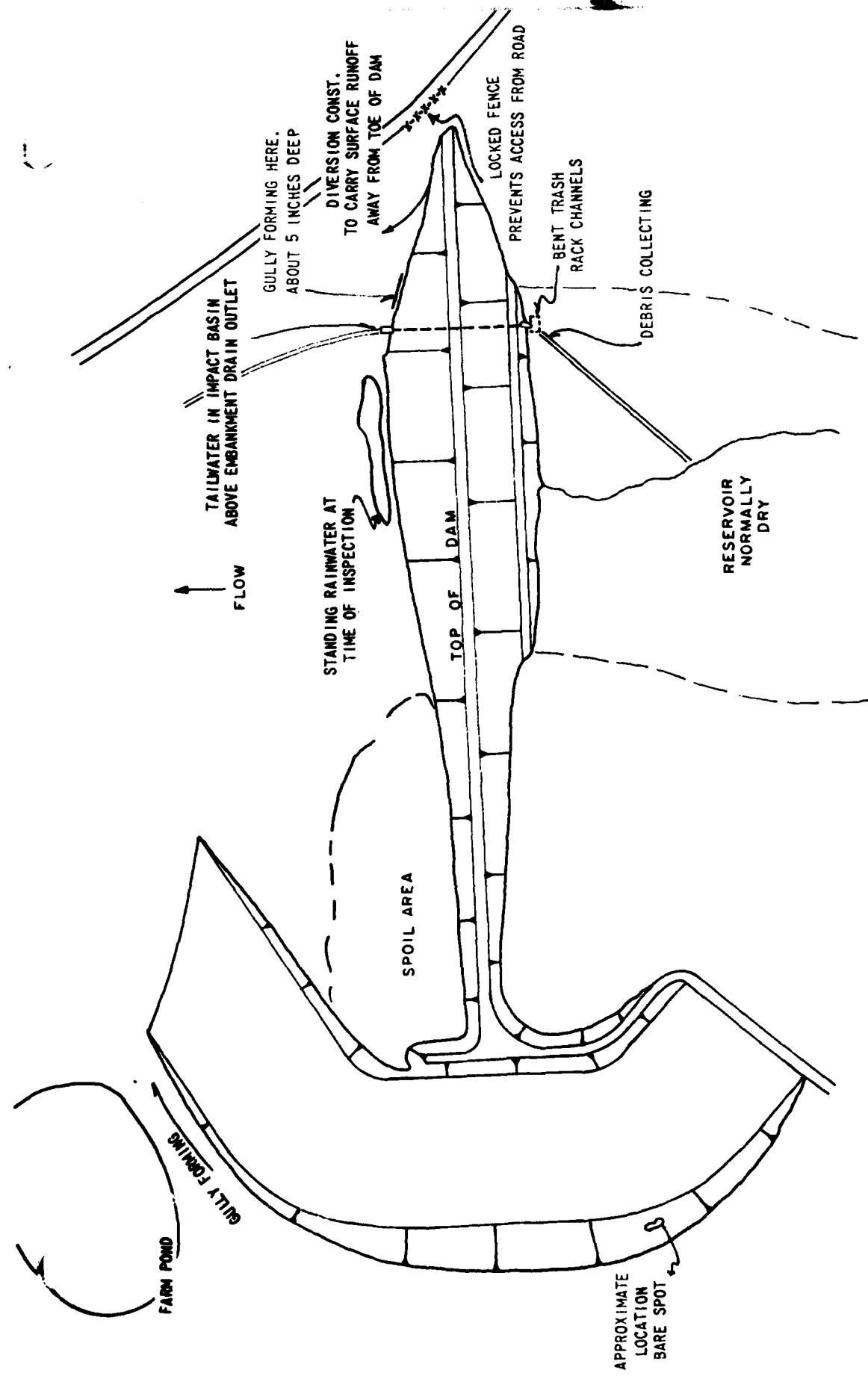
Sheet 3 of 11

<u>VISUAL EXAMINATION OF</u>	<u>OBSERVATIONS</u>	<u>REMARKS OR RECOMMENDATIONS</u>
SURFACE CRACKS, CONCRETE SURFACES	N/A	
STRUCTURAL CRACKING	N/A	
VERTICAL AND HORIZONTAL ALIGNMENT	N/A	
MONOLITH JOINTS	N/A	
CONSTRUCTION JOINTS	N/A	

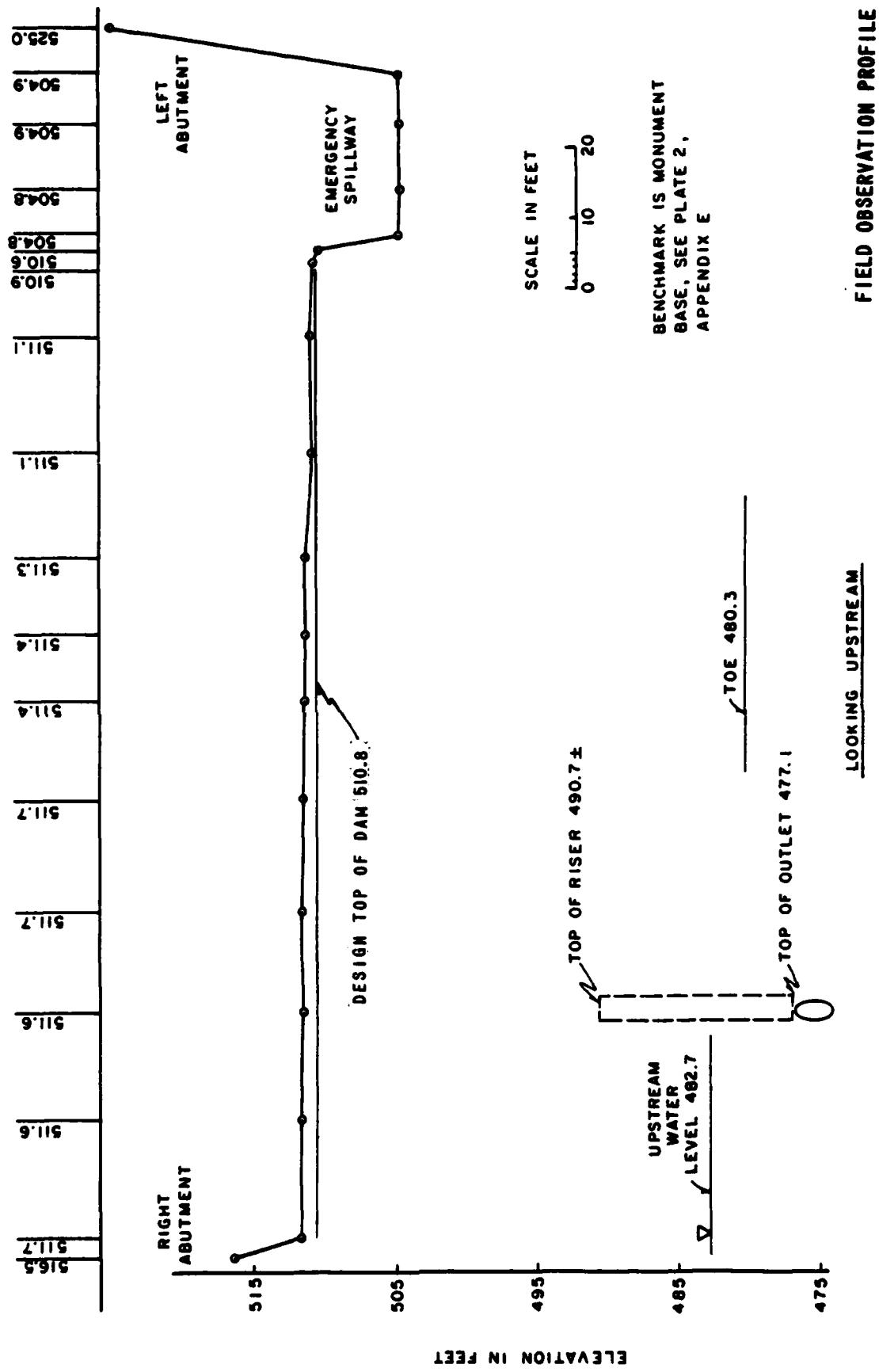
EMBANKMENT

<u>VISUAL EXAMINATION OF</u>	<u>OBSERVATIONS</u>	<u>REMARKS OR RECOMMENDATIONS</u>
SURFACE CRACKS	<i>None observed.</i>	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	<i>None observed.</i>	
SLoughing OR Erosion OF EMBANKMENT AND ABUTMENT SLOPES	<i>None observed.</i>	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST		<i>Good, see Sheet 5B.</i>
RIPRAP FAILURES		<i>None, riprap around riser and impact basin only.</i>

			Sheet 5 of 11
<u>EMBANKMENT</u>	<u>OBSERVATIONS</u>	<u>REMARKS OR RECOMMENDATIONS</u>	
<u>JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM</u>	<p>Upstream junction of embankment and right abutment in good condition. A small gully has started in the lower two-thirds of the downstream junction. The downstream junction between the embankment and left abutment appears to have a path worn through the vegetation but no damage to the embankment.</p>	<p>None observed, structure is a dry dam. At the time of inspection, rainwater was ponded beyond the dam toe.</p>	
<u>ANY NOTICEABLE SEEPAGE</u>			
<u>STAFF GAGE AND RECORDER</u>		<p>None</p>	
<u>DRAINS</u>		<p>Water level in impact basin was above drain invert and flow from drains could not be detected.</p>	



FIELD OBSERVATION PLAN  
BEAVER CREEK DAM  
SHEET 5A OF 11



SHEET 5B OF 11

PRINCIPAL SPILLWAY  
OUTLET WORKS

Sheet 6 of 11

<u>VISUAL EXAMINATION OF</u>	<u>OBSERVATIONS</u>	<u>REMARKS OR RECOMMENDATIONS</u>
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	30 inch conduit at base of dam could not be inspected.	
INTAKE STRUCTURE	Exposed portions appear in good condition with no cracking or spalling noted. It is noted that trash rack channels on the riser have been bent, reportedly by ice during the winter of 1977-78.	
OUTLET STRUCTURE	Exposed portions of the impact basin were inspected and found to be in good condition.	
OUTLET CHANNEL	The outlet channel between the dam and first downstream bridge is in good condition.	
EMERGENCY GATE	High water level prevented access to the riser. On 4/18/1980, the gate was closed and could not be opened.	

EMERGENCY SPILLWAY  
UNGATED SPILLWAY

Sheet 7 of 11

<u>VISUAL EXAMINATION OF</u>	<u>OBSERVATIONS</u>	<u>REMARKS OR RECOMMENDATIONS</u>
CONCRETE WEIR	<i>None, spillway is a grass lined trapezodial channel.</i>	
APPROACH CHANNEL	<i>Good condition, well vegetated.</i>	
DISCHARGE CHANNEL	<i>Good condition, well vegetated.</i>	
BRIDGE AND PIERS	<i>None</i>	

GATED SPILLWAY

Sheet 8 of 11

<u>VISUAL EXAMINATION OF</u>	<u>OBSERVATIONS</u>	<u>REMARKS OR RECOMMENDATIONS</u>
CONCRETE SILL	N/A	
APPROACH CHANNEL	N/A	
DISCHARGE CHANNEL	N/A	
BRIDGE AND PIERS	N/A	
GATES AND OPERATION EQUIPMENT	N/A	

<u>INSTRUMENTATION</u>		
<u>VISUAL EXAMINATION</u>	<u>OBSERVATIONS</u>	<u>REMARKS OR RECOMMENDATIONS</u>
MONUMENTATION/SURVEYS	<i>None</i>	
OBSERVATION WELLS	<i>None</i>	
WEIRS	<i>None</i>	
PIEZOMETERS	<i>None</i>	
OTHER	<i>None</i>	

VISUAL EXAMINATION OF		
<u>RESERVOIR</u>	<u>OBSERVATIONS</u>	<u>REMARKS OR RECOMMENDATIONS</u>
<u>SLOPES</u>	<p>Reservoir side slopes are moderate with grass and wood lands.</p>	
<u>SEDIMENTATION</u>		<p>Small amount of sediment at upper end from farming activities. No effect on computed flood water storage.</p>

DOWNSTREAM CHANNEL

Sheet 11 of 11

<u>VISUAL EXAMINATION OF</u>	<u>OBSERVATIONS</u>	<u>REMARKS OR RECOMMENDATIONS</u>
<u>CONDITION</u> (OBSTRUCTIONS, DEBRIS, ETC.)	<p><i>The channel between the dam and first downstream bridge is in good condition. The channel side slopes are grassed and about 2H:1V.</i></p>	
<u>SLOPES</u>	<p><i>The valley gradient is about 0.005.</i></p>	
<u>APPROXIMATE NO. OF HOMES AND POPULATION</u>		<p><i>In the first two river miles below the dam are 4 or 5 houses subject to damage in the event of failure of the dam. At Bondsville, 2 miles below the dam, additional homes and an unoccupied factory would be damaged.</i></p>

**APPENDIX**

**B**

CHECK LIST	NAME OF DAM	Beaver Creek Dam
ENGINEERING DATA	IU #	(SGS PA 433)
DESIGN, CONSTRUCTION, OPERATION		PA 00903
PHASE 1		

Sheet 1 of 4

REMARKS

AS-BUILT DRAWINGS      *As-built drawings are located in the Owner's files, DER files and Soil Conservation files.*

REGIONAL VICINITY MAP      *See Plate 1, Appendix E.*

CONSTRUCTION HISTORY      *See text, Section 1.2.*

TYPICAL SECTIONS OF DAM      *Sections and plans are included in Appendix E.*

OUTLETS - PLAIN	DETAILS	CONSTRAINTS
	<i>See Appendix E.</i>	
DISCHARGE RATINGS	<i>See Appendix D.</i>	
RAINFALL/RESERVOIR RECORDS	<i>None</i>	

ITEM	REMARKS
DESIGN REPORTS	<i>Located in DER and SCS files.</i>
GEOLOGY REPORTS	<i>Located in DER and SCS files.</i>
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	<i>Located in Design folder prepared by SCS.</i>
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	<i>Performed by SCS.</i>
POST-CONSTRUCTION SURVEYS OF DAM	<i>See Appendix A, sheet 5B</i>
BORROW SOURCES	<i>Reservoir area and emergency spillway excavation.</i>

ITEM	REMARKS
MONITORING SYSTEMS	<i>None</i>
MODIFICATIONS	<i>None</i>
HIGH POOL RECORDS	<i>None</i>
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	<i>None</i>
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	<i>None</i>
MAINTENANCE OPERATION RECORDS	<i>None, although inspection records are maintained by SCS and the Owner.</i>

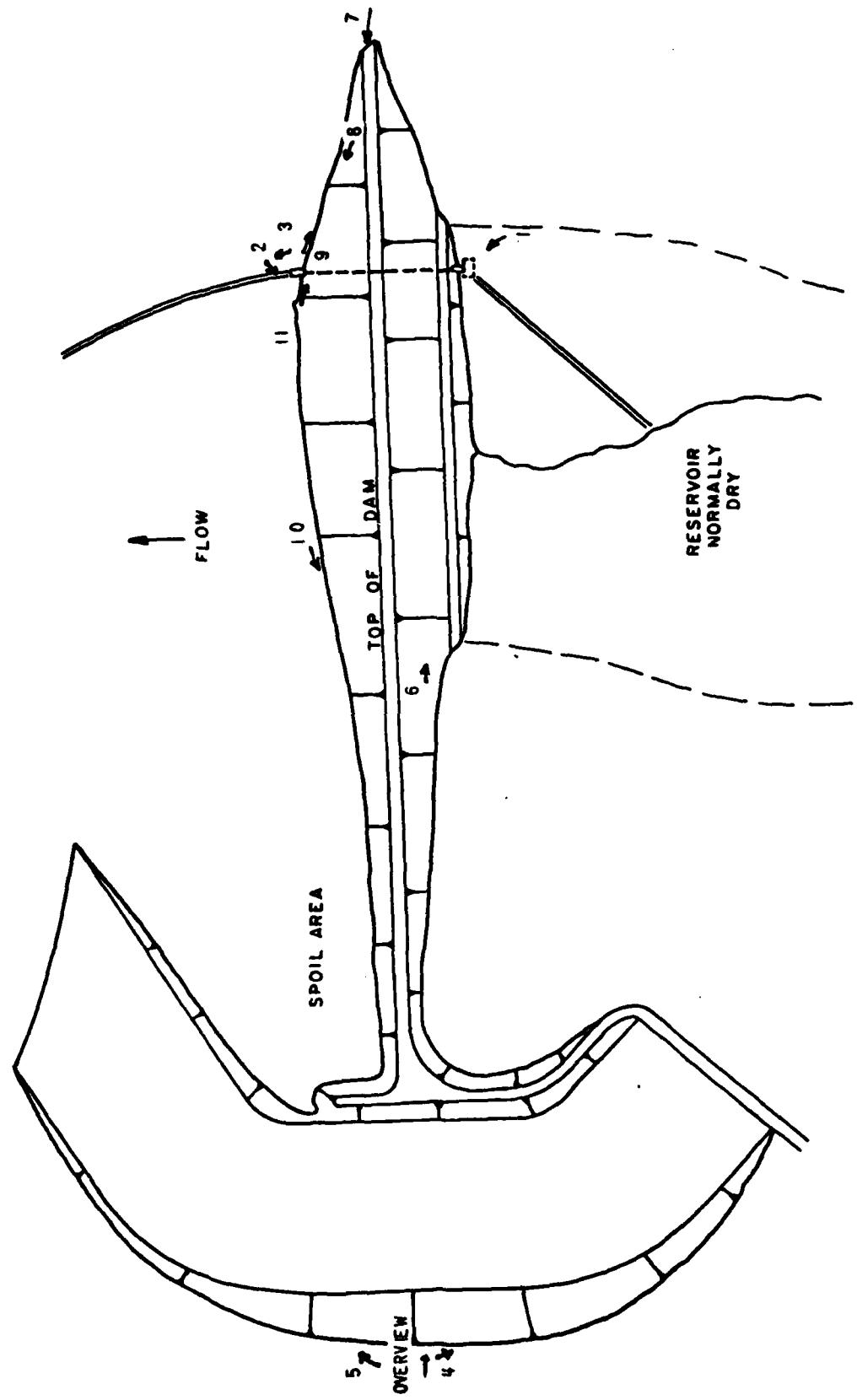
ITEM	REMARKS
SPILLWAY PLAN	
SECTIONS	<i>See Appendix E.</i>
DETAILS	
OPERATING EQUIPMENT PLANS & DETAILS	<i>See Appendix E.</i>
MISCELLANEOUS	<ol style="list-style-type: none"><li>1. SCS design folder of several hundred pages.</li><li>2. 33 sheet set of as-built drawings prepared by SCS.</li><li>3. Progress reports by Frederick H. Schuetz, Project Engineer.</li><li>4. 18 color photographs taken by DER personnel during construction.</li><li>5. Post construction inspection reports prepared by SCS.</li><li>6. Erosion and Sediment Control Plan prepared by SCS.</li><li>7. Correspondence located in DER file.</li></ol>

**APPENDIX**

**C**

PHOTOGRAPH LOCATION PLAN  
BEAVER CREEK DAM

PLATE C-1





RISE AT UPSTREAM TOE.

PHOTOGRAPH NO. 1



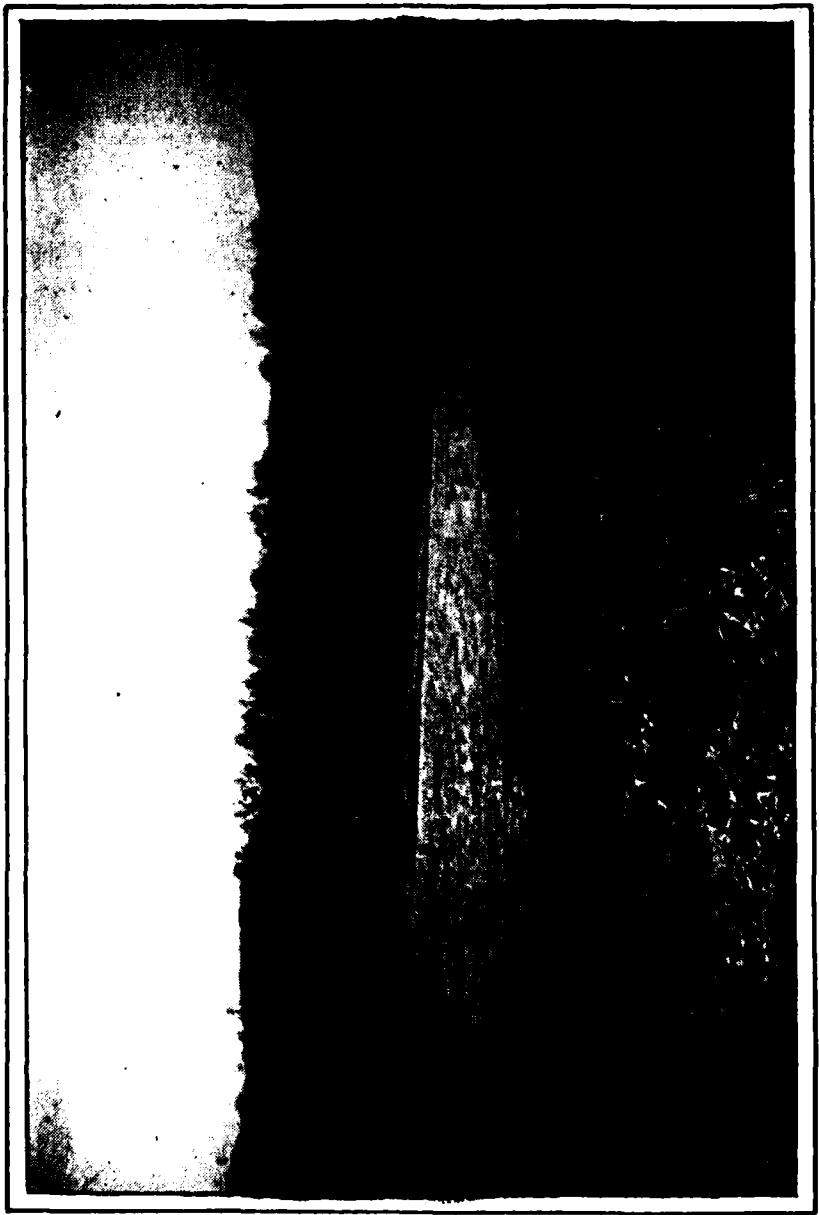
PHOTOGRAPH NO. 2

IMPACT BASIN AT DOWNSTREAM TOE.  
TAILWATER IS ABOVE EMBANKMENT  
DRAIN OUTLET INVERT



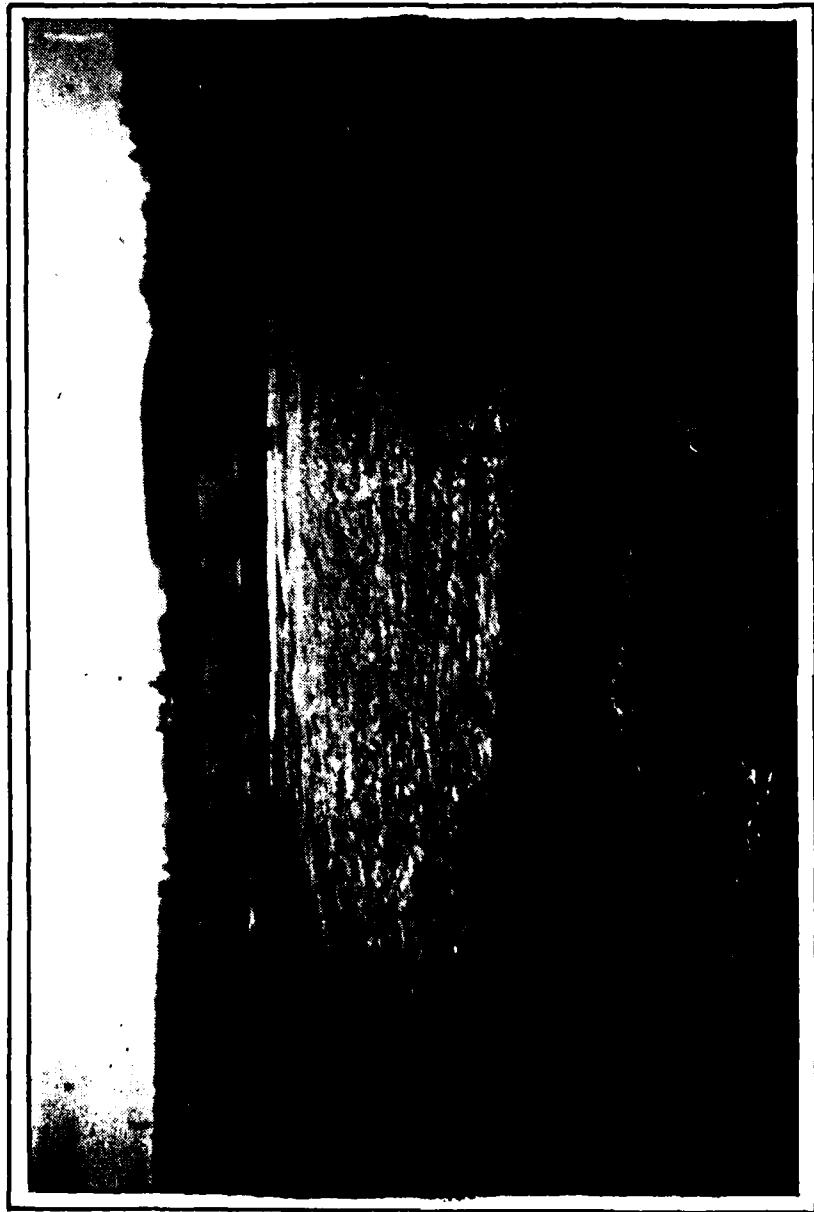
VIEW OF CHANNEL IMMEDIATELY BELOW THE  
DAM.

PHOTOGRAPH NO. 3



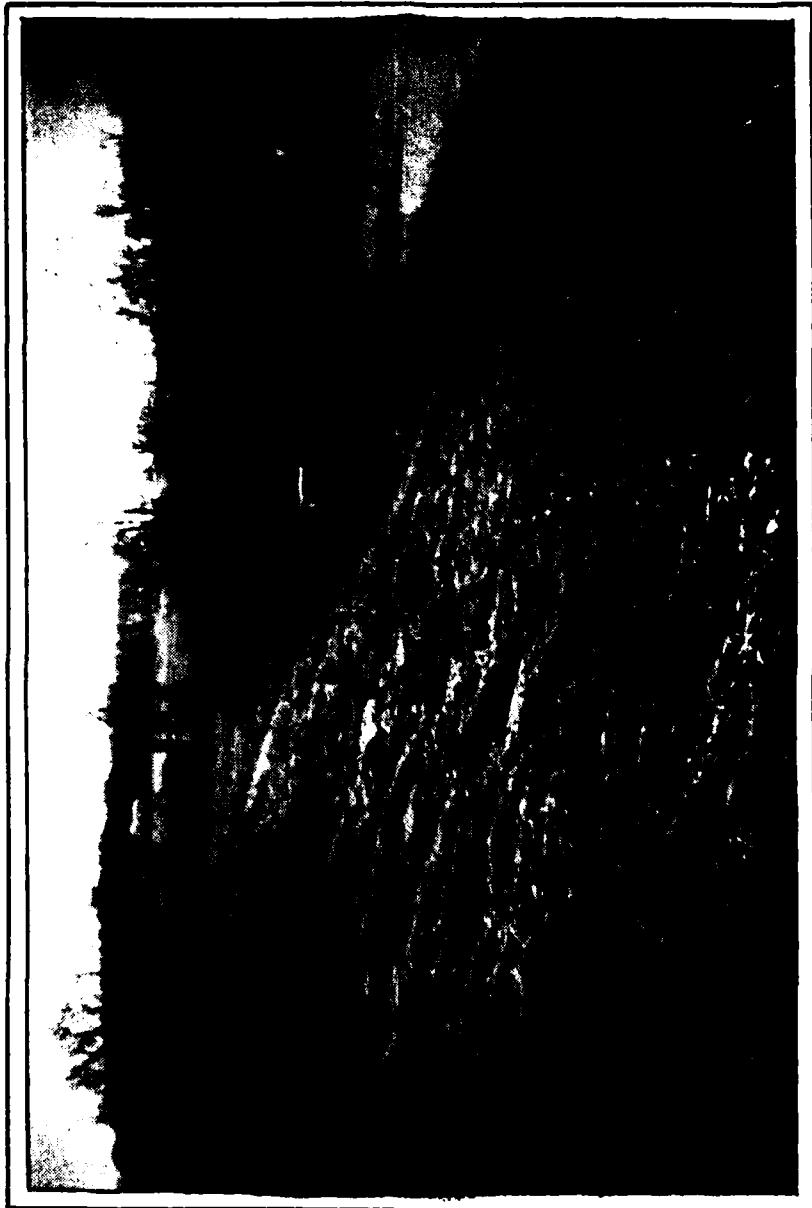
OVERALL VIEW OF EMERGENCY SPILLWAY  
LOOKING UPSTREAM.

PHOTOGRAPH NO. 4



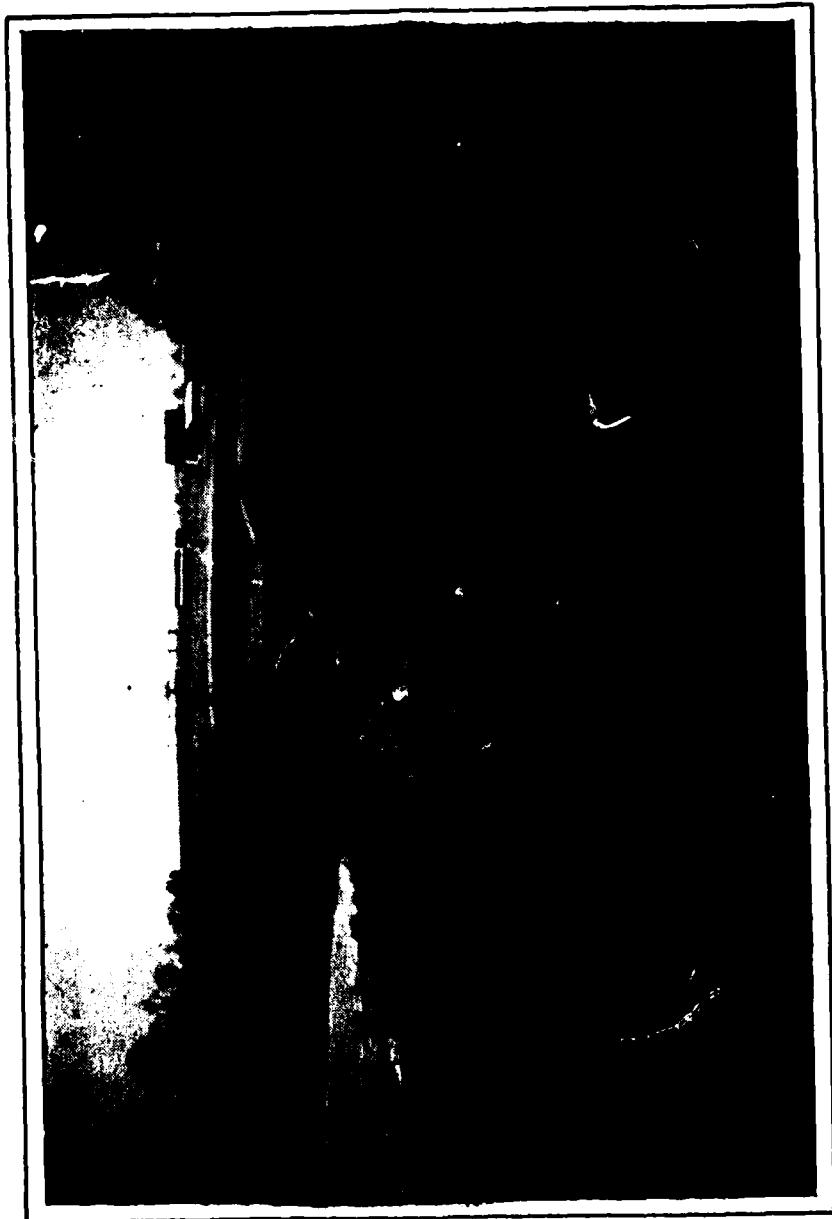
OVERALL VIEW OF EMERGENCY SPILLWAY  
LOOKING DOWNSTREAM.

PHOTOGRAPH NO. 5



OVERALL VIEW OF UPSTREAM SLOPE.  
DORMANT VEGETATION IS IN GOOD  
CONDITION.

PHOTOGRAPH NO. 6



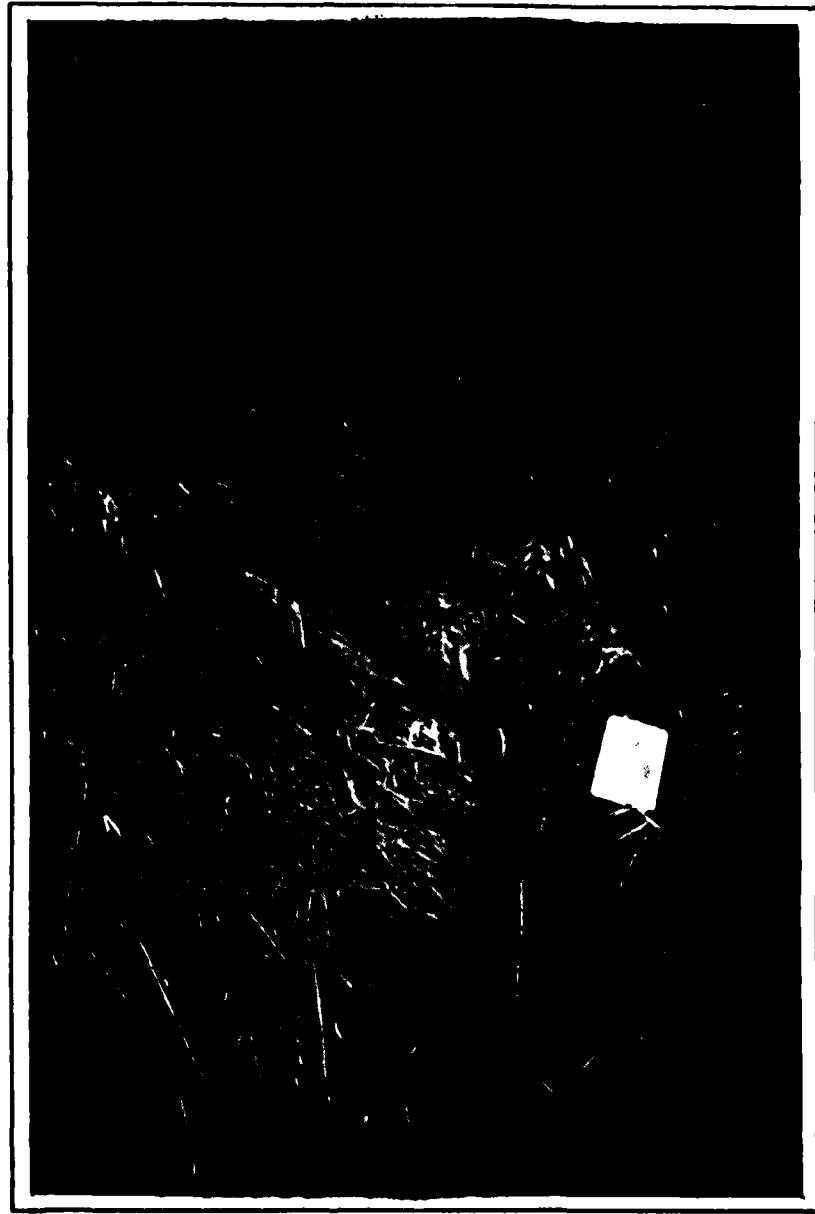
OVERALL VIEW OF CREST PROTECTED BY  
GRAVEL ROAD.

PHOTOGRAPH NO. 7



OVERALL VIEW OF DOWNSTREAM SLOPE.

PHOTOGRAPH NO. 8



DOWNTSTREAM JUNCTION OF  
EMBANKMENT AND RIGHT  
ABUTMENT. FIVE INCH  
EROSION SCARP IS UNDER  
VEGETATION.

PHOTOGRAPH NO. 9



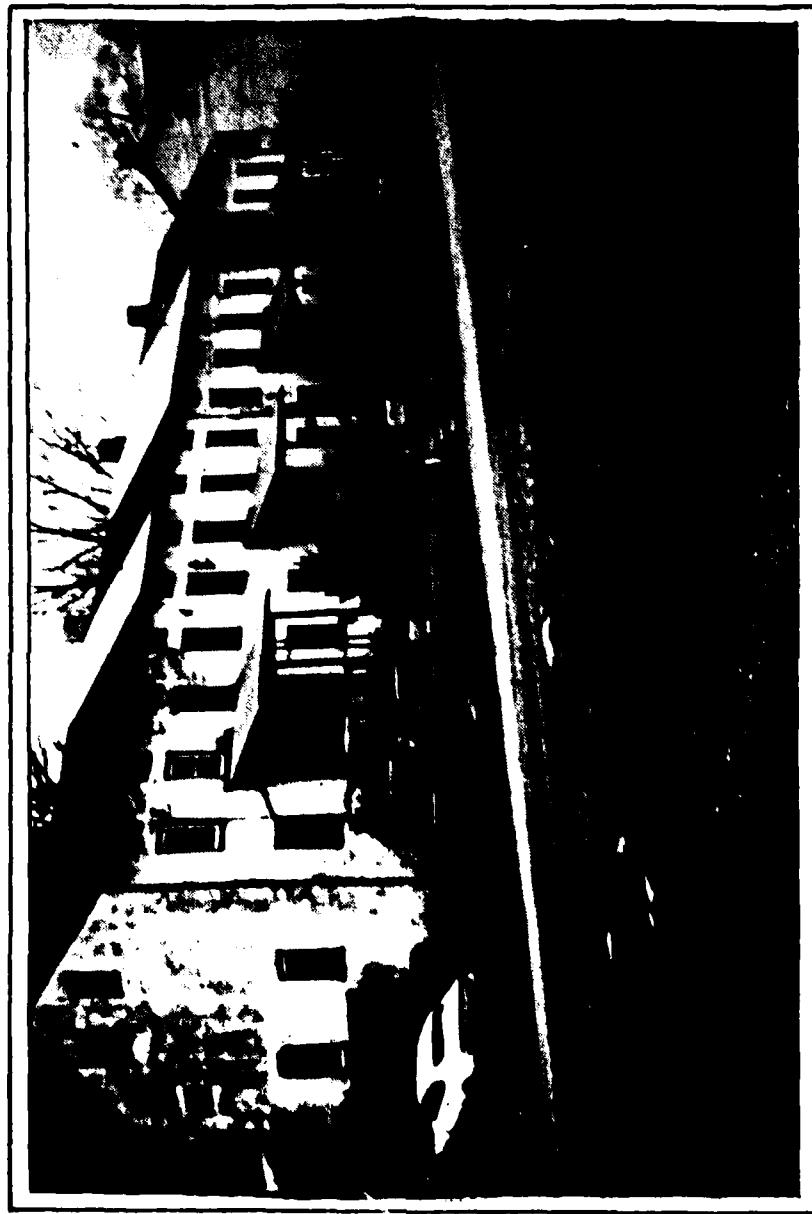
DOWNSTREAM JUNCTION OF  
EMBANKMENT AND LEFT  
ABUTMENT. PATH WORN  
THROUGH VEGETATION.

PHOTOGRAPH NO. 10



MINOR EROSION BETWEEN IMPACT BASIN AND  
EMBANKMENT.

PHOTOGRAPH NO. 11



DOWNTSTREAM HAZARD CENTER AT BONDSTVILLE.

PHOTOGRAPH NO. 12

**APPENDIX**

**D**

Beaver Creek Dam  
(SCS PA 433)  
CHECK LIST  
HYDROLOGIC AND HYDRAULIC  
ENGINEERING DATA

Sheet 1 of 6

DRAINAGE AREA CHARACTERISTICS: Predominantly open/farm land, less than 1% residential.

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): Dry, pond drain at 477.5 feet.

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 510.8 feet (1464 Acre-Feet)

ELEVATION MAXIMUM DESIGN POOL: 506.6 feet design high water.

ELEVATION TOP DAM: 510.8 feet.

EMERGENCY SPILLWAY

- a. Elevation 504.8 feet.
- b. Type Trapezoidal vegetated channel.
- c. Width 225 feet.
- d. Length 500 feet.
- e. Location Spillover left abutment.
- f. Number and Type of Gates None.

PRINCIPAL SPILLWAY

- a. Type single-stage concrete drop inlet riser, 30 inch conduit and impact basin.
- b. Location Dam station 16+50, maximum section.
- c. Entrance inverts 486.6 feet.
- d. Exit inverts 474.5
- e. Emergency draindown facilities 24 inch pond drain orifice at 477.5.

HYDROMETEOROLOGICAL GAGES:

- a. Type None within watershed.
- b. Location N/A
- c. Records N/A

MAXIMUM NON-DAMAGING DISCHARGE: Not determined.

Beaver Creek Dam  
(SCS PA 433)  
HYDROLOGIC AND HYDRAULIC  
BASE DATA

Sheet 2 of 6

DRAINAGE AREA: (1) 3.1 square miles.

PROBABLE MAXIMUM PRECIPITATION (PMP)  
USED IN DESIGN: (1) 26 inches in 6 hours.

HYDROGRAPH PARAMETERS: (1)

Runoff Curve Number 72

Time of Concentration 2.5 hours

SPILLWAY CAPACITY AT MAXIMUM  
WATER LEVEL: (1) 9409 cfs.

(1) From SCS Design Folder

BY MEB DATE 3/3/80 SUBJECT Beaver Creek Dam  
CHKD BY \_\_\_\_\_ DATE \_\_\_\_\_ SHEET 3 OF 6  
JOB NO. Hydrology / Hydraulics

Classification (Ref: Recommended Guidelines for Safety  
Inspection of Dams)

1. The hazard potential is rated as "High" as there would be excessive economic loss and loss of life in the event of failure.
2. The size classification is "Intermediate" based on its 1,464 Ac-Ft total storage capacity.
3. The spillway design flood, based on size and hazard classification, is the Probable Maximum Flood (PMF).

#### Hydrologic and Hydraulic Analysis

The H & H design folder was available for review. The PMF (no freeboard) hydrograph was determined according to procedures in the SCS National Engineering Handbook, Section 4. Hydrograph calculations and flood routing were performed by the SCS computer program, TR-20. Portions of the original design folder are included in this Appendix.

Original design parameters were checked against current information and/or criteria. Drainage area shown on sheet 2 was verified from USGS map.

Runoff curve number calculations, sheet 4, represent a 25% developed watershed. Current development is estimated to be about 1%.

Based on review of the design folder, the original PMF flood routing is judged adequate. Therefore, the spillways for this structure are considered "Adequate".

## Frost: Workplay

## Brandywine Creek

H.L.W. 4/68

H.LW 4/68 PA-433

PA-433

15

SHEET 4 OF 6

PLANTING AREA (A) = 2016 AC = 3.1 SC MM

REFERENCE: NEW SECTION 4

Ref. SCS Design  
Folder

SUM 20.16 144,280

WEIGHTED CURVE NO. II =  $\frac{(51)}{(3)} = 17.6$  USE 17.6

RECORDING CURVE NO. 10

ADMITTED CURVE NO. 2 - SEE "LEM-SECTION 4" A CONVERSION TABLE

E-SS DESIGN AND FREEBOARD ROUTINGS:

BRANDYWINE CREEK WATERSHED PA 433

MAR 1972 JDS  
X WATERSHED PA 433

CURVE NO. 12. TC 2.50 : STORM DURATION 6.00.

EMER. SPW. RAINFALL 10.75 FREEBOARD RAINFALL 26.00  
2. DRAINAGE AREA 3.10 EMER. SPW. CREST - 504.00

ELFVATION	STORAGE	CFS	CFS	CFS
486.61	43.	0.	0.	56.
488.60	71.	56.	56.	56.
492.79	184.	72.	72.	72.
496.98	359.	84.	84.	84.
500.12	505.	93.	93.	93.
503.26	718.	100.	100.	100.
504.80	843.	104.	104.	104.
505.30	884.	200.	216.	224.
505.80	925.	451.	478.	504.
506.30	966.	798.	851.	904.
506.40	974.	910.	972.	1034.
507.80	1128.	2490	2673.	2856.
509.30	1294.	4969.	5243.	5716.
510.59	1436.	7722.	8207.	8892.
510.80	1464.	8170.	8790.	9409.
512.30	1658.	12015.	12930.	13845.
513.80	1852.	17426.	17680.	18934.
514.59	1955.	20955.	20554.	22013.

SHEET 5 OF 6

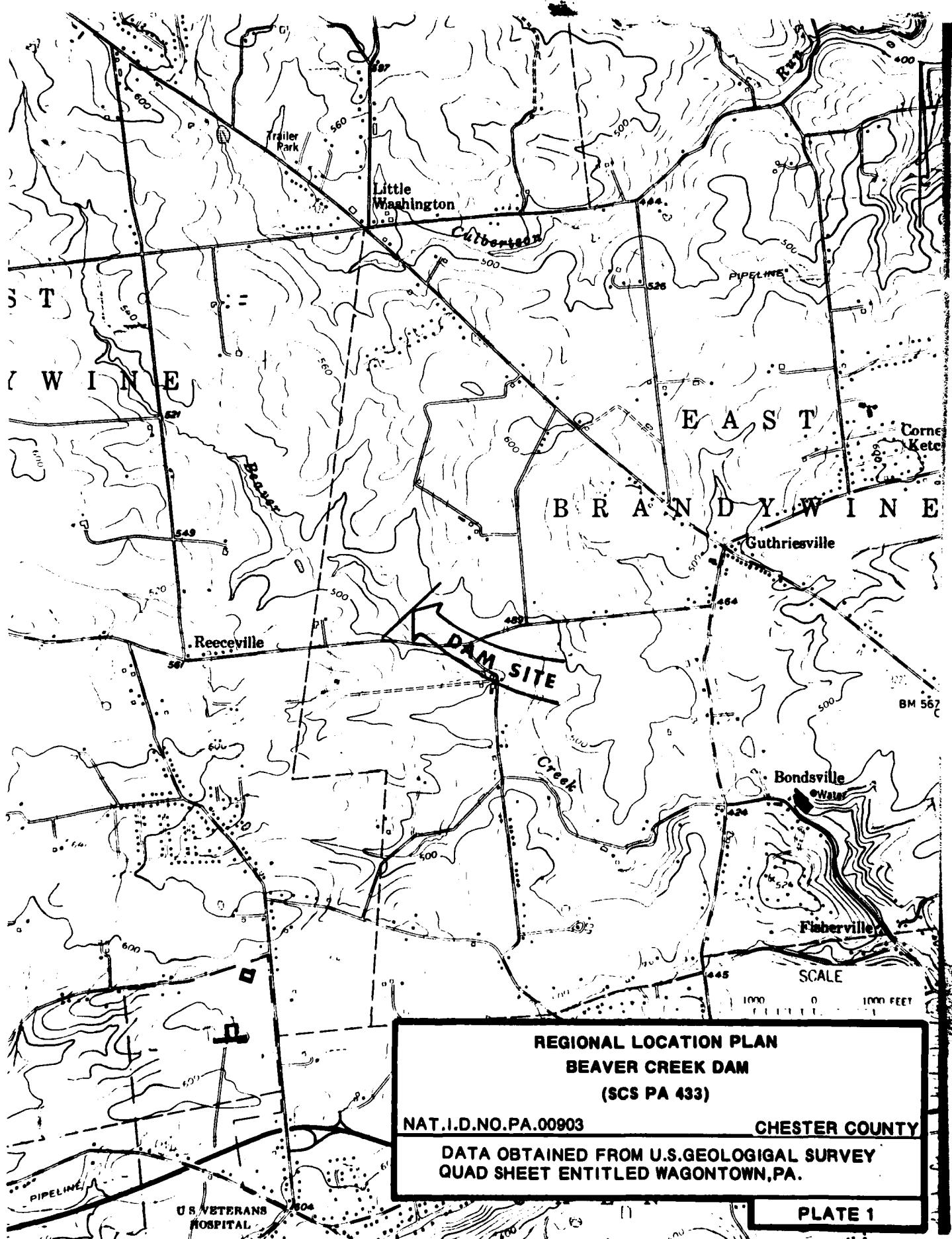
**Ref. SCS Design  
Folder**

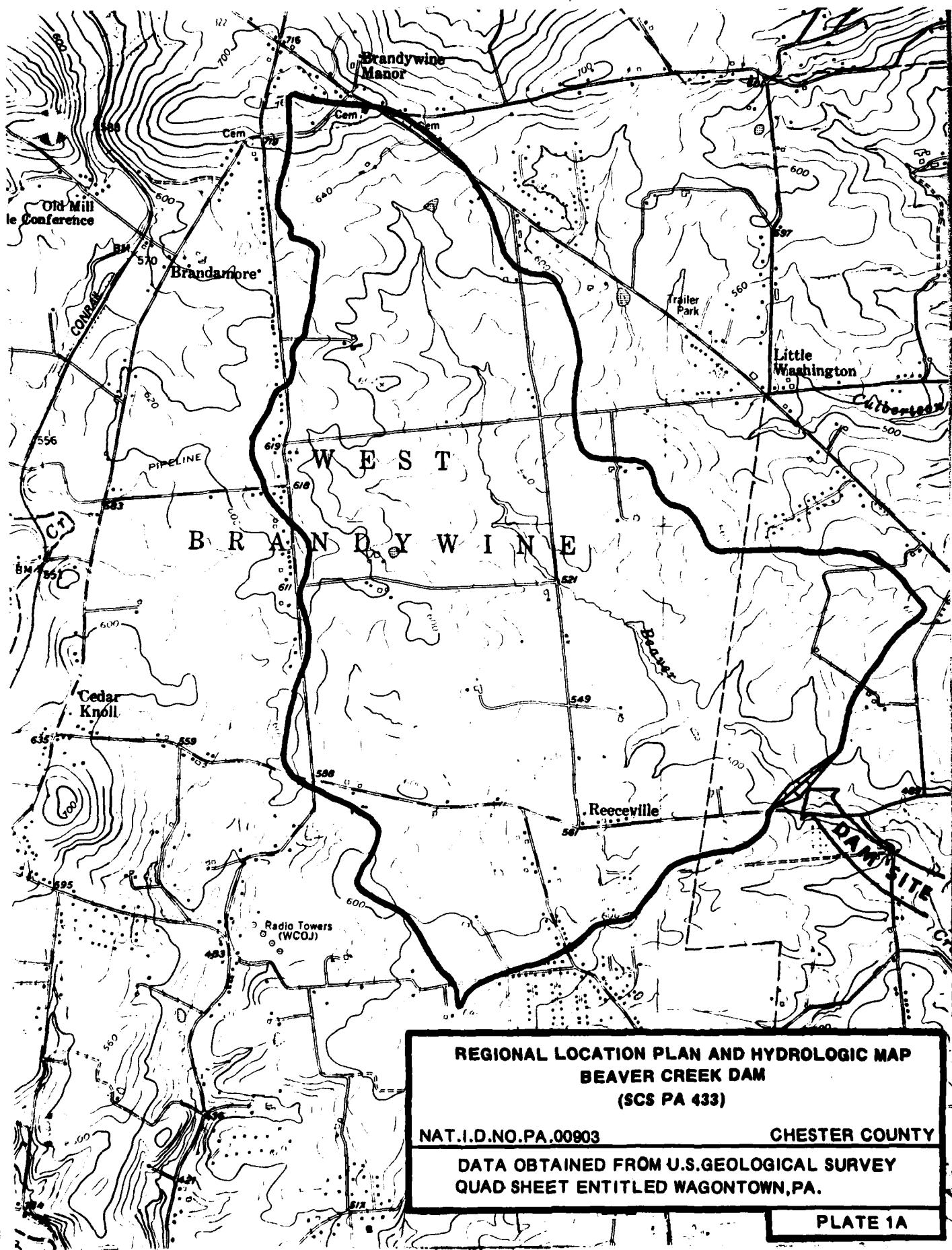
FREEBOARD POUTING					ELEV.
TIME	INFLOW	AVE IN	OUTFLOW		
0.25	0.	0.	0.		486.60
0.50	2.	1.	0.		486.61
0.75	10.	6.	0.		486.62
1.00	46.	28.	1.		486.63
1.25	101.	73.	4.		486.70
1.50	269.	185.	11.		487.02
1.75	504.	386.	27.		487.54
2.00	1028.	766.	56.		488.61
2.25	1861.	1445.	60.		489.87
2.50	3109.	2483.	67.		491.53
2.75	4866.	3986.	75.		493.91
3.00	6835.	5851.	94.		496.76
3.25	8800.	7817.	93.		500.17
3.50	10477.	9638.	100.		503.09
3.75	11435.	10956.	519.		505.81
4.00	11761.	11598.	2897.		507.82
4.25	11613.	11687.	5559.		509.21
4.50	10999.	11306.	7674.		510.94
4.75	10290.	10645.	8786.		510.54
5.00	9471.	9884.	9160.		510.69
PEAK OCCURS PREVIOUS LINE					
5.25	8709.	9093.	9138.		510.48
5.50	8000.	8353.	8879.		510.59
5.75	7373.	7687.	8432.		510.40
6.00	6778.	7075.	7924.		510.19
6.25	6241.	6509.	7395.		509.98
6.50	5697.	5969.	6861.		509.76
6.75	5134.	5415.	6319.		509.54
7.00	4540.	4832.	5764.		502.31
7.25	3922.	4231.	5291.		509.07
7.50	3319.	3620.	4785.		508.81
7.75	2734.	3027.	4252.		508.53
8.00	2246.	2491.	3719.		508.25
8.25	1819.	2034.	3209.		507.98
8.50	1461.	1643.	2769.		507.73
8.75	1193.	1330.	2457.		507.49
9.00	950.	1072.	2156.		507.26
9.25	776.	863.	1875.		507.04
9.50	619.	696.	1619.		506.84
9.75	489.	552.	1388.		506.67
10.00	382.	436.	1181.		506.51
10.25	292.	337.	987.		506.36
10.50	228.	260.	824.		506.20
10.75	172.	200.	709.		506.05
11.00	135.	154.	607.		505.92
11.25	103.	119.	518.		505.81
11.50	79.	91.	457.		505.71
11.75	60.	76.	406.		505.62
12.00	44.	52.	359.		505.54
12.25	34.	39.	317.		505.46
12.50	24.	29.	279.		505.39
12.75	17.	21.	244.		505.33
13.00	11.	15.	220.		505.28
13.25	6.	9.	207.		505.22

Ref. SCS Design  
Folder

**APPENDIX**

**E**





**REGIONAL LOCATION PLAN AND HYDROLOGIC MAP  
BEAVER CREEK DAM  
(SCS PA 433)**

**NAT. I.D. NO. PA. 00903**

**CHESTER COUNTY**

**DATA OBTAINED FROM U.S. GEOLOGICAL SURVEY  
QUAD SHEET ENTITLED WAGONTOWN, PA.**

**PLATE 1A**

1. NURBLES AREAS TO BE GRADED AND THE AREA ARE USED AS DICTATED BY THE ENGINEER.
2. STRUCTURE AREA TO BE GRADED AND GRADED AS DIRECTED BY THE ENGINEER.
3. RE-PAVED AREA AND SPOT AREA TO BE GRADED - GRADED AS DIRECTED BY THE ENGINEER.
4. LOCATION OF DIVERSIONS, SEDIMENT BASIN, FILTER LINES, AND STREAM DIVERSIONS ARE AN INDICATOR. FINAL LOCATION WILL BE DETERMINED BY THE ENGINEER.
5. EXISTING PROFILE WITHIN THE CONSTRUCTION LIMITS TO BE REMOVED.
6. SPOT AREA SHALL BE LEFT WITH AT LEAST ONE FOOT OF COVER OVER ANY BURNS, LOGS, STOLES, AND ROTTERS. AFTER SPOT MATERIAL IS PLACED, SPOT AREA SHALL BE SHAPED TO PROVIDE POSITIVE DRAWDOWN AS DIRECTED BY THE ENGINEER.
7. IMPRESS AND EXPRESS ROAD SHALL BE GRADED AND GRADED AS APPROVED BY THE ENGINEER AND SHALL BE CONSTRUCTED AND MAINTAINED BY THE CONTRACTOR.
8. SLOPES OF NURBLES AREAS AND SPOT AREA SHALL NOT BE STEEPER THAN THREE TO ONE.
9. NURBLES AREAS MAY BE UTILIZED AS SPOT AREA AFTER REQUIRED FILL MATERIAL HAS BEEN PLACED AS DIRECTED BY THE ENGINEER.

CLASS 1A - Diversion

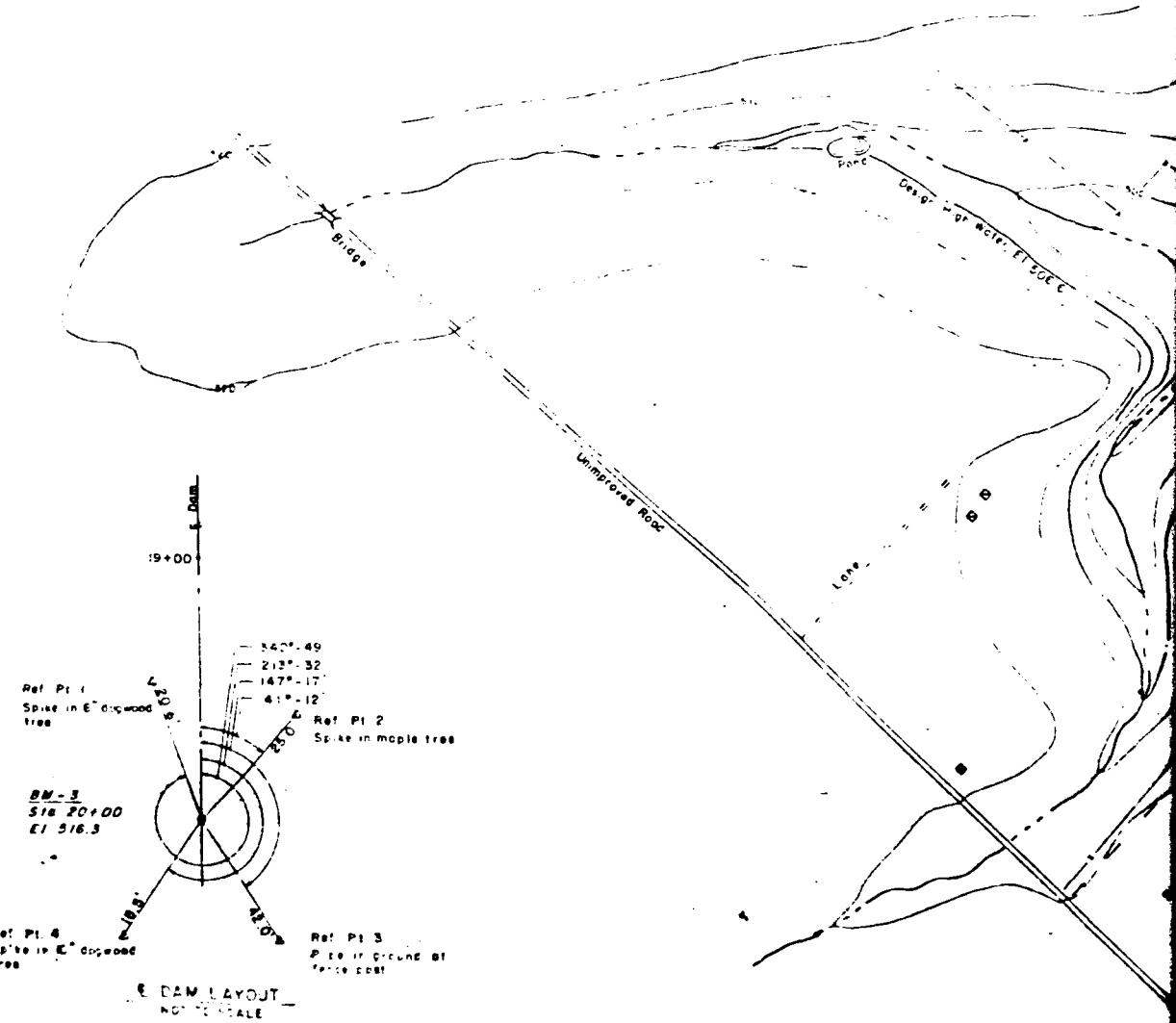
• - - - - 100' half foot

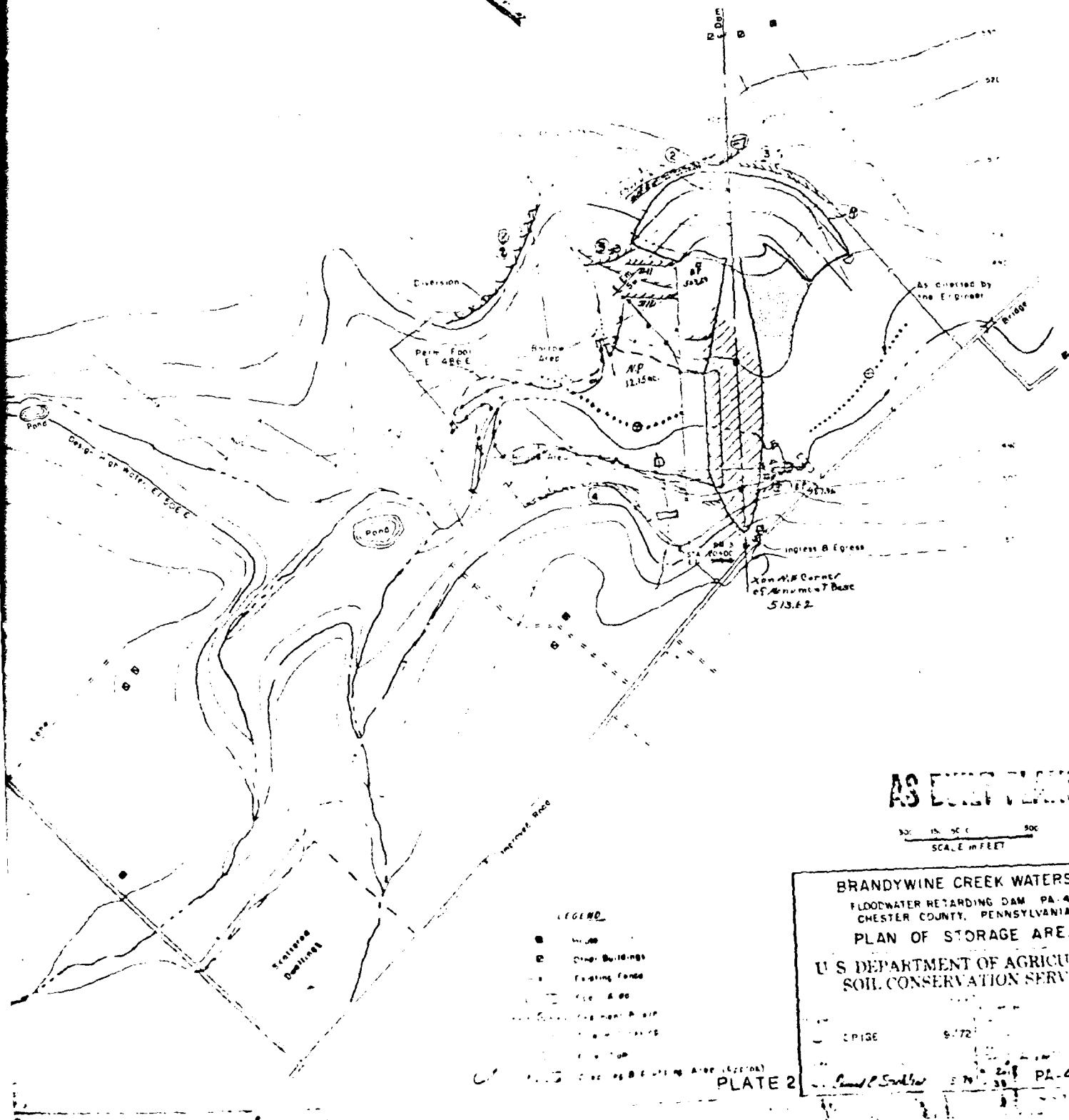
□ Sediment Basin

• - - - - Sediment Basin

260888 Stream Waterway

1 - - - Stream Crossing



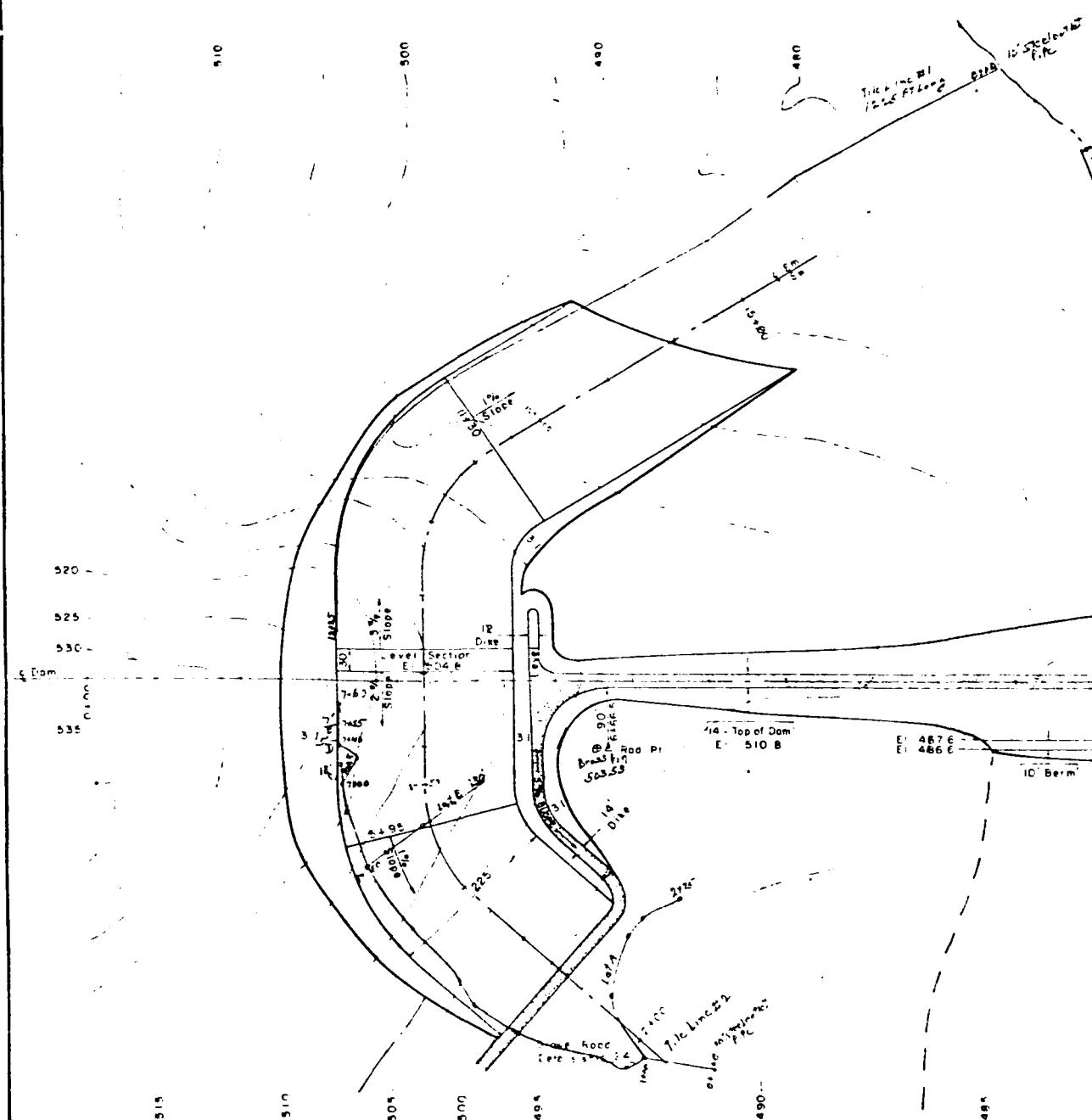


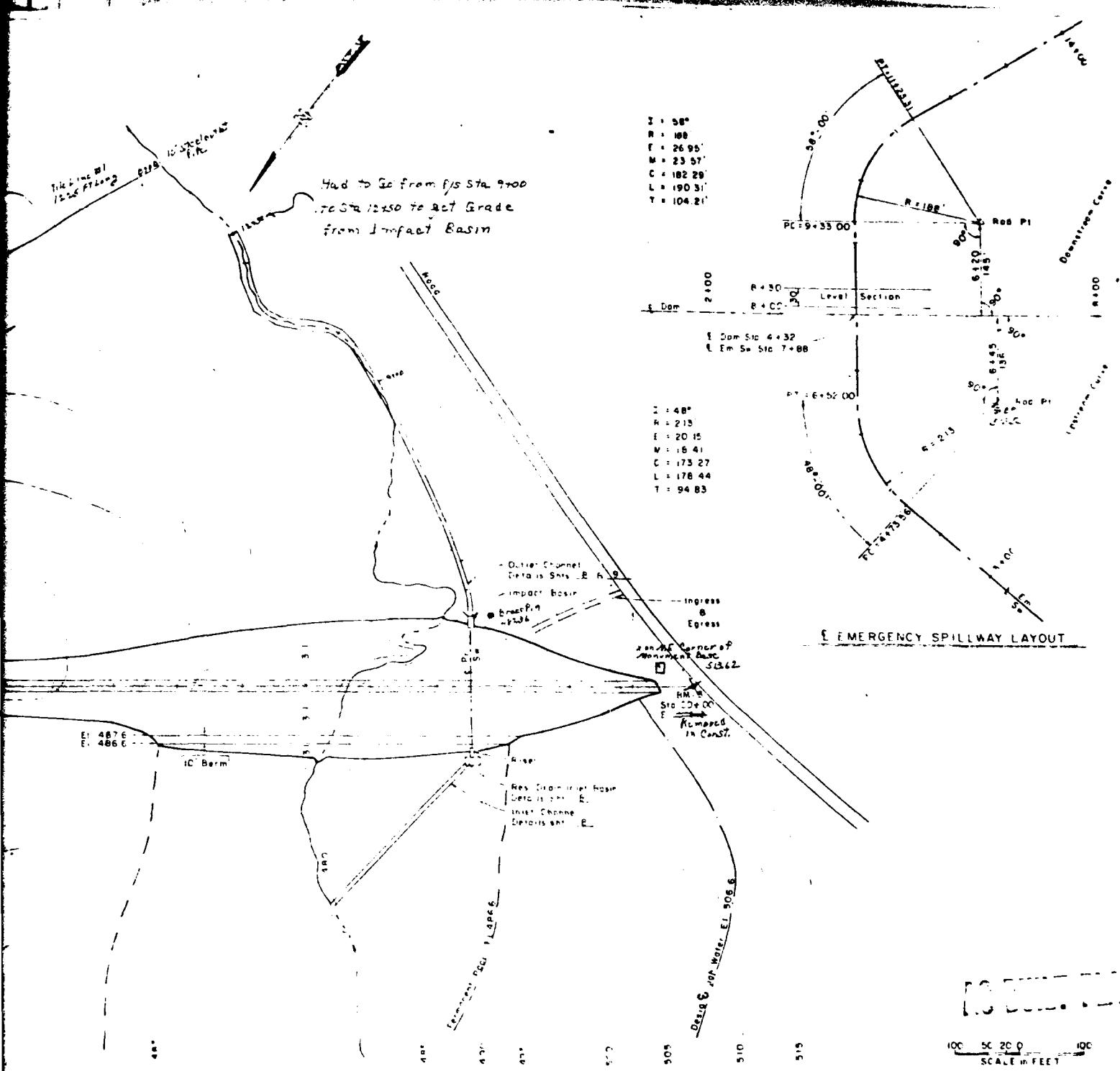
## AS EASY AS

300 15 900  
SCALE in FEET

BRANDYWINE CREEK WATERSHED  
FLOODWATER RETARDING DAM, PA. 432  
CHESTER COUNTY, PENNSYLVANIA  
PLAN OF STORAGE AREA  
U.S. DEPARTMENT OF AGRICULTURE  
SOIL CONSERVATION SERVICE

James P. Sankler 2018 PL-433-P





## BRANDYWINE CREEK WATERSHED

FLOODWATER RETARDING DAM PA-433  
CHESTER COUNTY PENNSYLVANIA

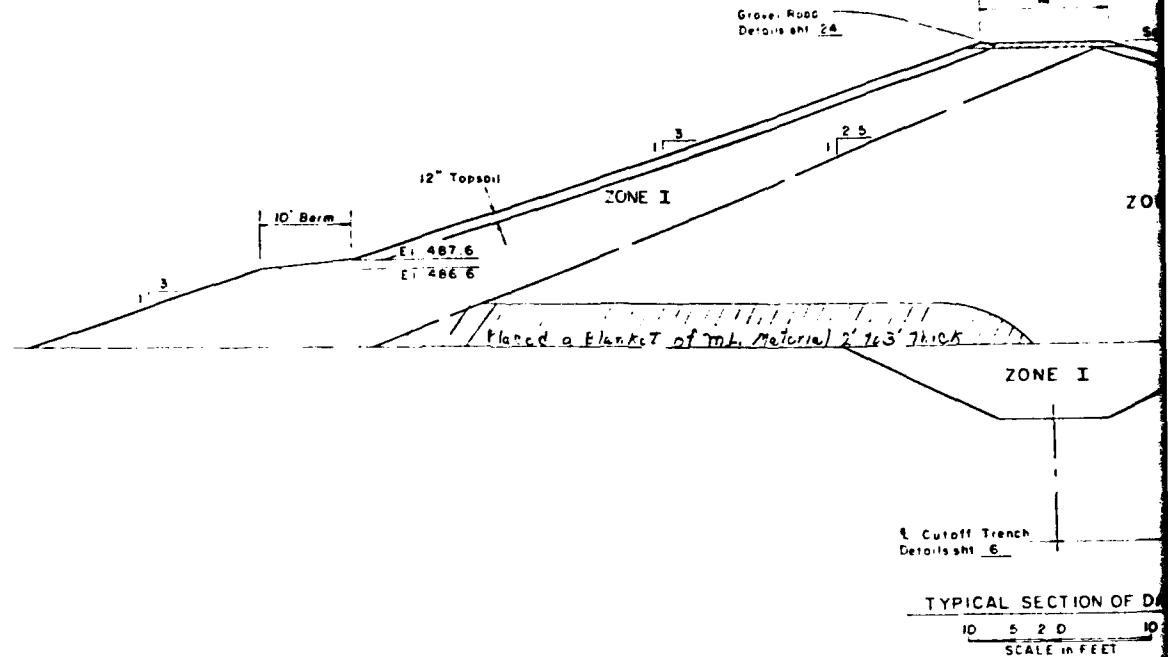
## PLAN OF STRUCTURAL WORKS

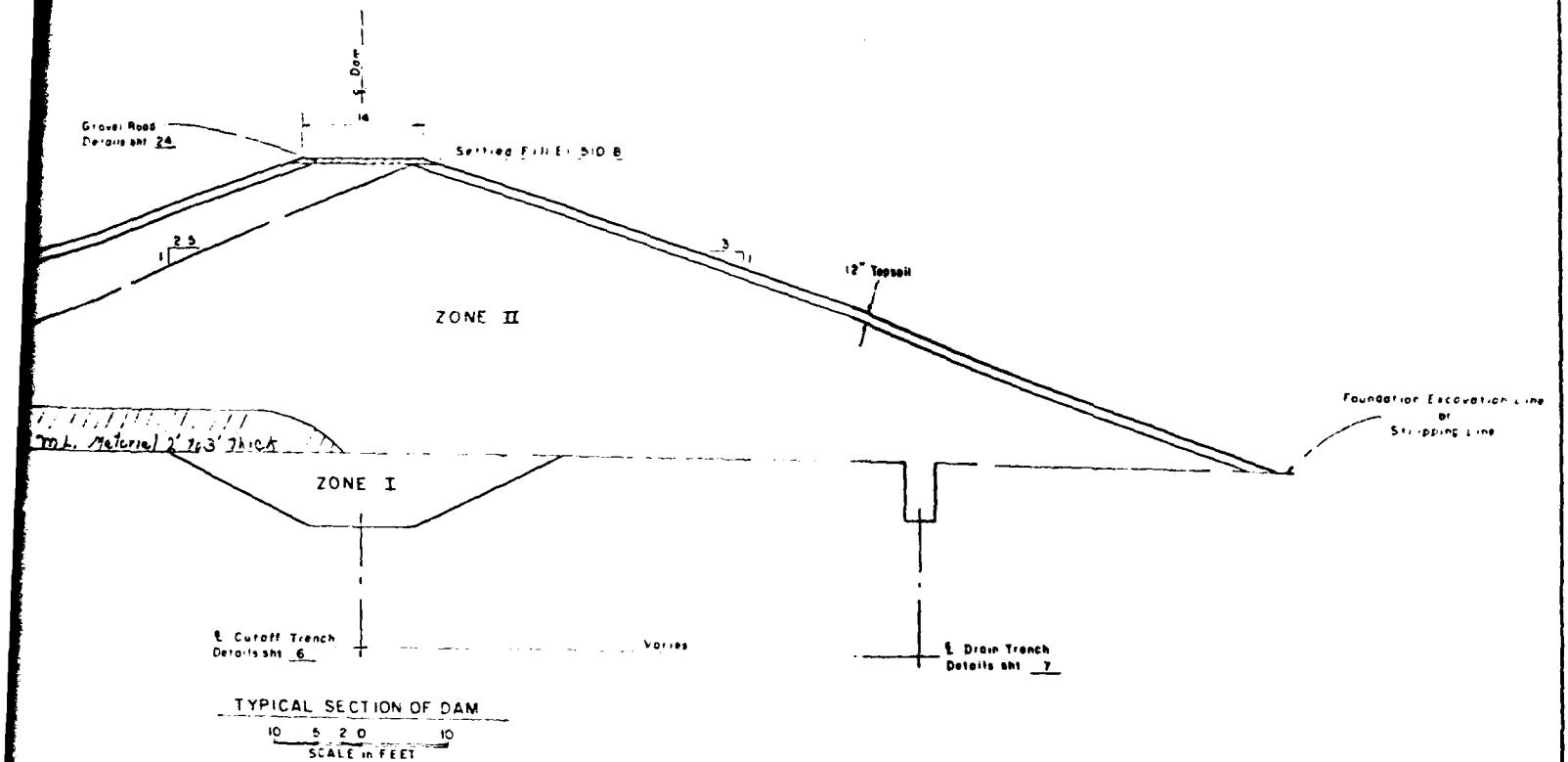
U. S. DEPARTMENT OF AGRICULTURE  
SOIL CONSERVATION SERVICE

PLATE 3

Frank S. Sander 374

PA 433-





#### CONSTRUCTION NOTES

1. Constructed slopes are 2:3 upstream and downstream
2. For constructed fill elevations see sh. 5

PLACEMENT	MATERIAL	MAX ROCK SIZE	MAX LIFT	REQ'D WATER CONTENT	COMPACTION	
					CLASS	DEFINITION
Zone I	Material as represented by TP-215, depth 1'-3'; TP-105, depth 0'-3'; TP-116, depth 0'-2'; classified as CL, ML & SM respectively	6"	9"	Optimum + 2%	A	95% Max density by ASTM D-698, Method "A"
Zone II	Material as represented by TP-215, depth 3'-7'; TP-105, depth 3.5'-6.5'; classified as SM	6"	9"	Optimum - 2% to + 2%	A	95% Max density by ASTM D-698, Method "A"

1. Maximum permissible lift thickness before compaction
2. Water content of fill matrix at time of compaction. Variation from water content shown may be approved by the Engineer
3. For typical compaction curves see sh. 33.
4. Zone I material is to be used to backfill foundation excavation
5. For hand compacted backfill, the max. rock size and lift thickness shall not exceed one half of the size and thickness shown.

#### BRANDYWINE CREEK WATERSHED

FLOODWATER RETARDING DAM PA-433  
CHESTER COUNTY, PENNSYLVANIA

#### FILL PLACEMENT

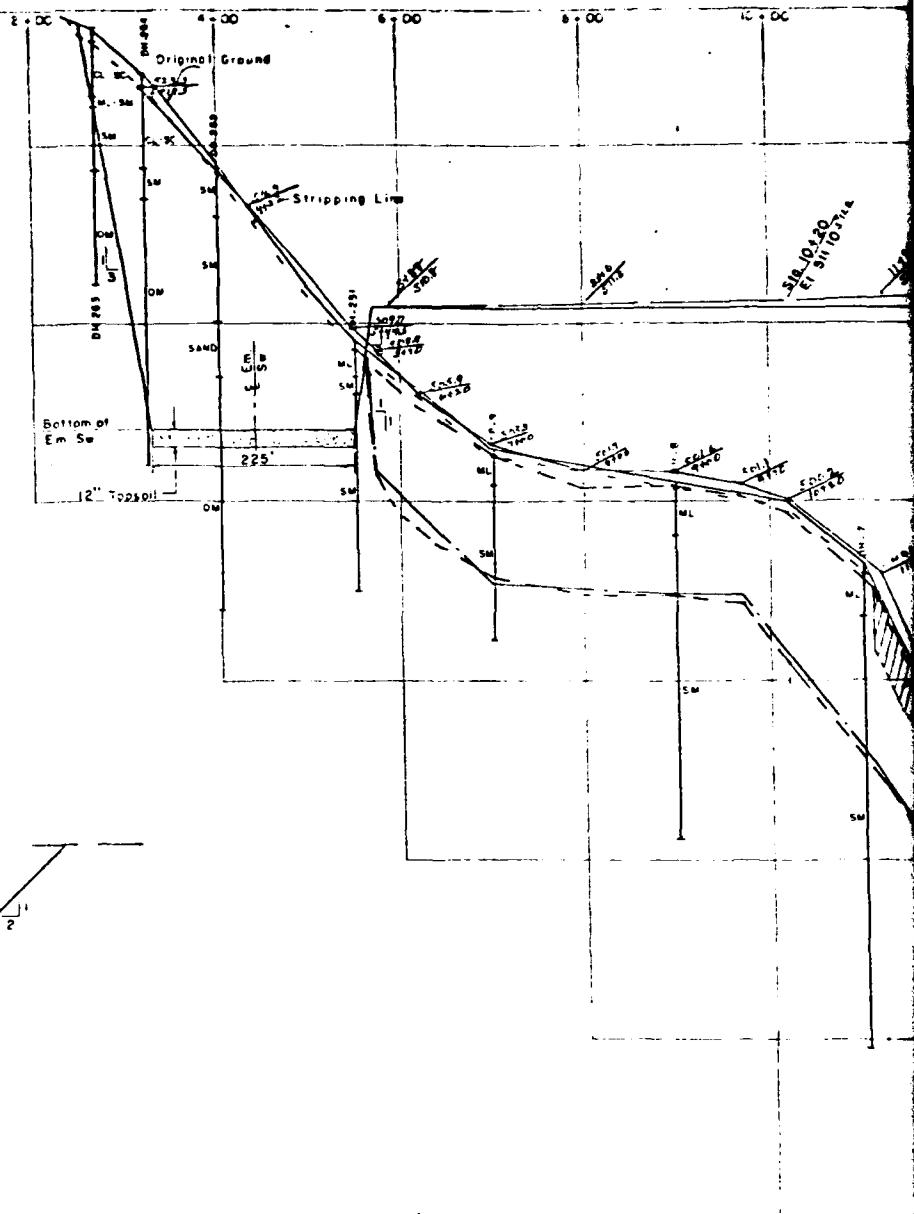
U. S. DEPARTMENT OF AGRICULTURE  
SOIL CONSERVATION SERVICE

CRIME 10-72

PLATE 4

Paul C. Stoltz

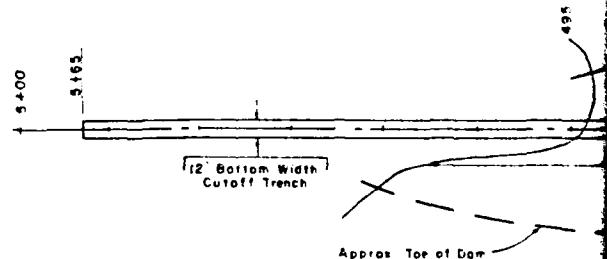
PA-433-P

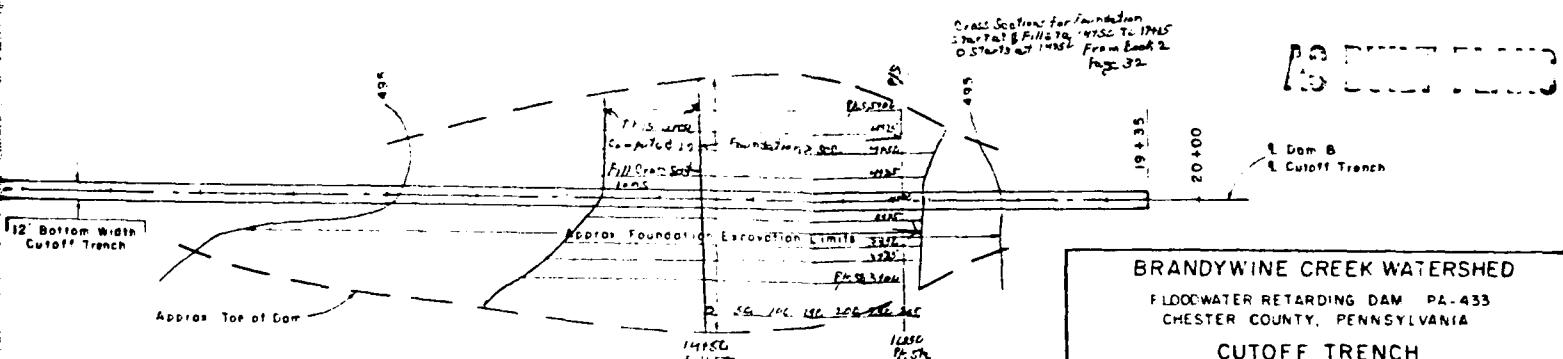
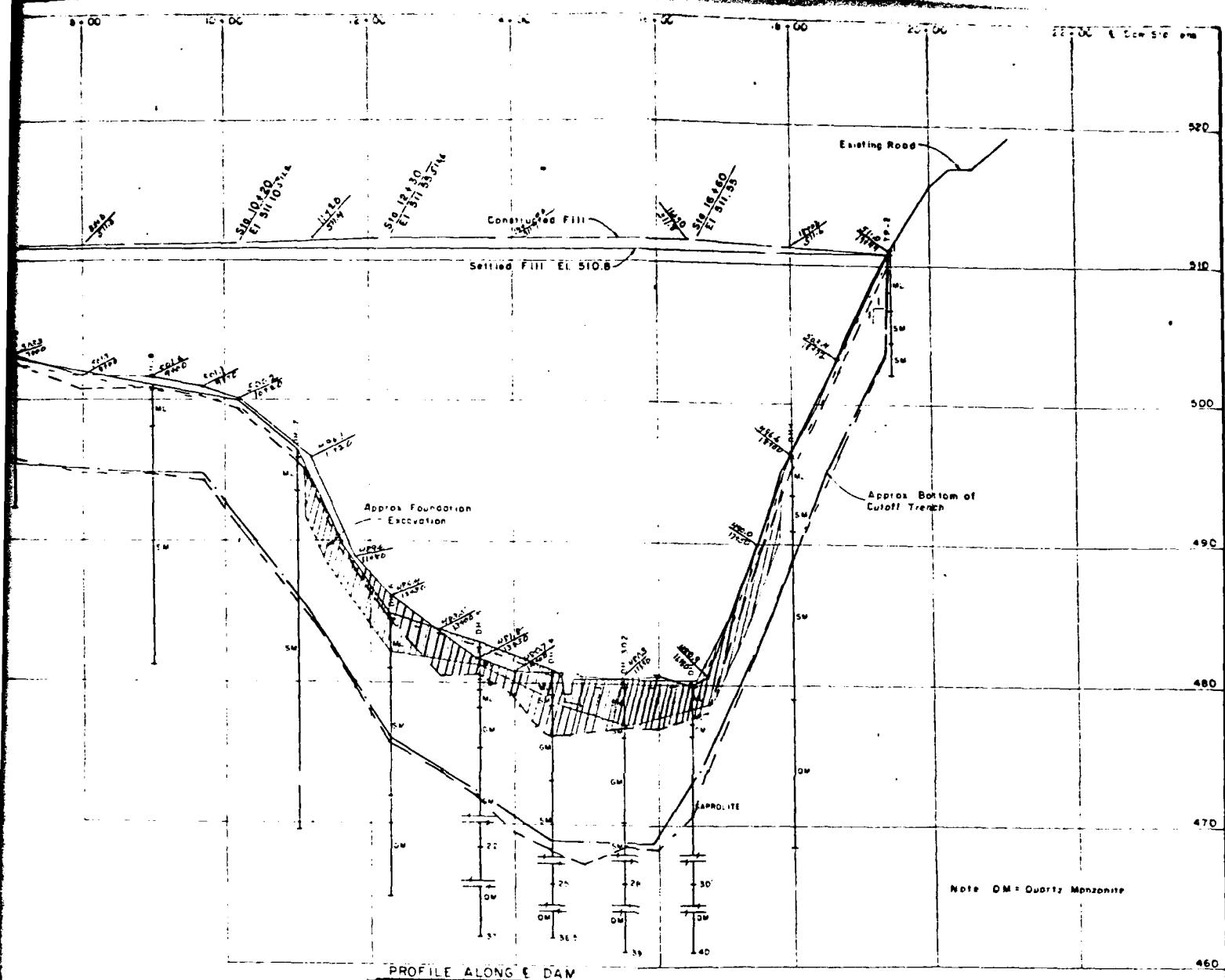


### TYPICAL SECTION

## CONSTRUCTION NOTES

1  $\mathbb{E}$  Dam =  $\mathbb{E}$  Cutoff Trench  
2 For logs of test holes see shts 26 thru 32





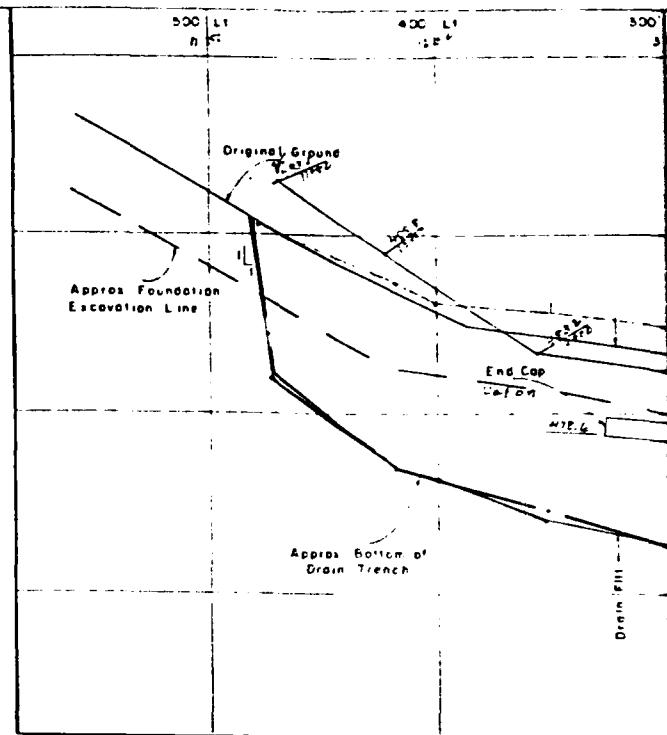
BRANDYWINE CREEK WATERSHED  
FLOODWATER RETARDING DAM PA-433  
CHESTER COUNTY, PENNSYLVANIA  
CUTOFF TRENCH  
U. S. DEPARTMENT OF AGRICULTURE  
SOIL CONSERVATION SERVICE

CR181 9-72

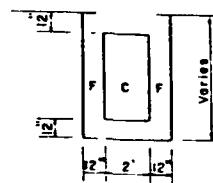
PLATE 5

General P. S. 3-74 6 PA-433-D

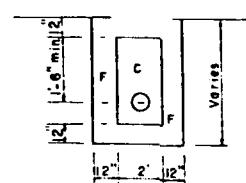
PLAN VIEW  
1/4" = 10' 0"



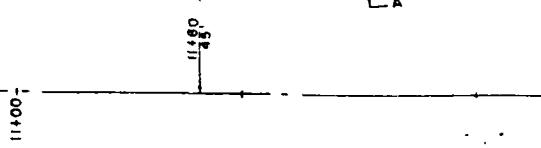
Original Ground



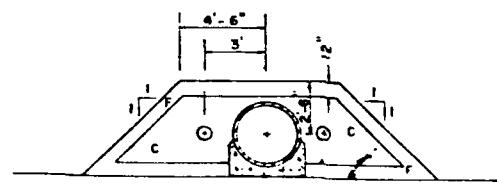
SECTION A-A



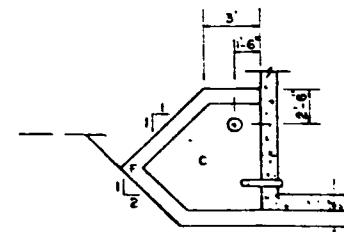
SECTION B-B



11'-0"

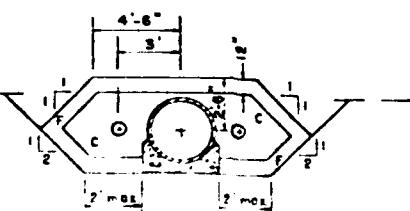


SECTION C-C

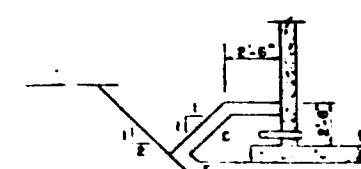


SECTION D-D

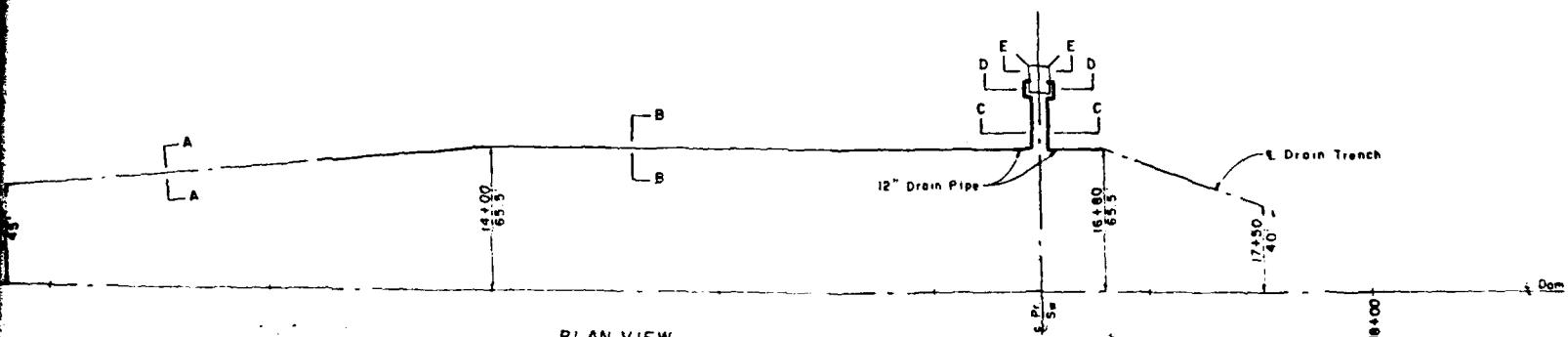
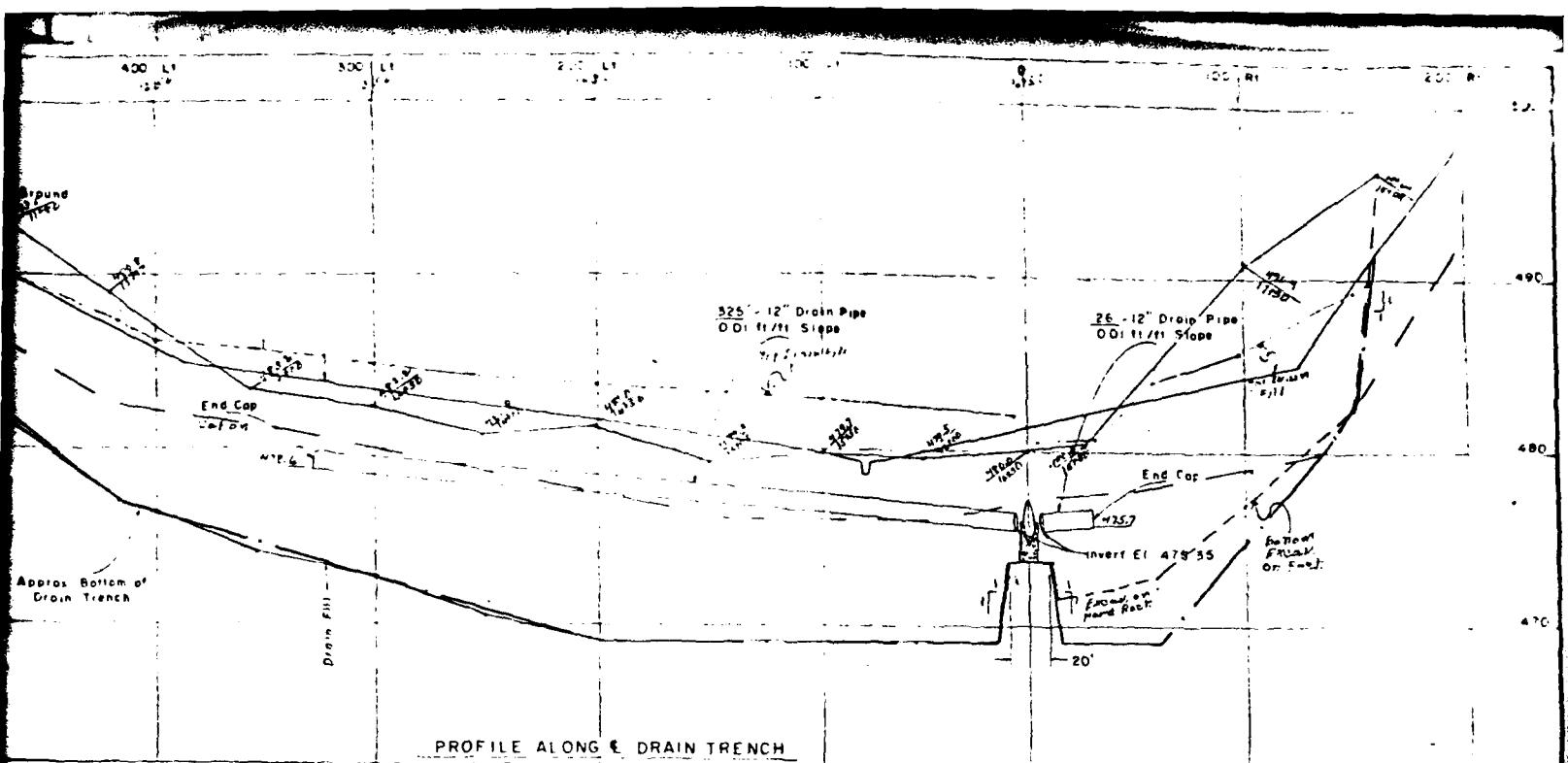
Foundation Exc. Line



SECTION C-C



SECTION E-E



PLAN VIEW

GRADATION LIMITS FOR DRAIN FILL		"COARSE"	"FINE"
SEIVE NO.	% PASSING (Based on Dry Weight)	SEIVE NO.	% PASSING (Based on Dry Weight)
1/2	100	3/8	100
3/8	75 - 100	no 4	90 - 100
no 4	10 - 30	no 8	70 - 92
no 8	0 - 10	no 16	50 - 80
no 200	5 - 3	no 30	30 - 65
		no 50	10 - 30
		no 100	1 - 8
		no 200	≤ 3
			15

#### CONSTRUCTION NOTE

All drain pipe shall be 12" dia., Class I or II,  
Shape 1, Coating A, 16 Gage, Perforated,  
Spec. 551.

C = Coarse Drain Fill  
F = Fine Drain Fill

#### QUANTITY SUMMARY

19 - 20' Sections  
 2 - 10' Sections  
 2 - 7' Sections  
 2 - 1' - 8" Sections  
 2 - 1' - 6" Sections  
 1 - 5' Section  
 1 - 6' Section  
 8 - 90° Elbows (1'-4" x 1'-4")  
 2 - End Caps  
 2 - Small Animal Guards (sht 24)  
 452-B - Total

Note Lengths given may be varied as approved by the Engineer

## AS BUILT PLANS

**BRANDYWINE CREEK WATERSHED**  
**FLOODWATER RETARDING DAM PA-433**

## DRAINAGE

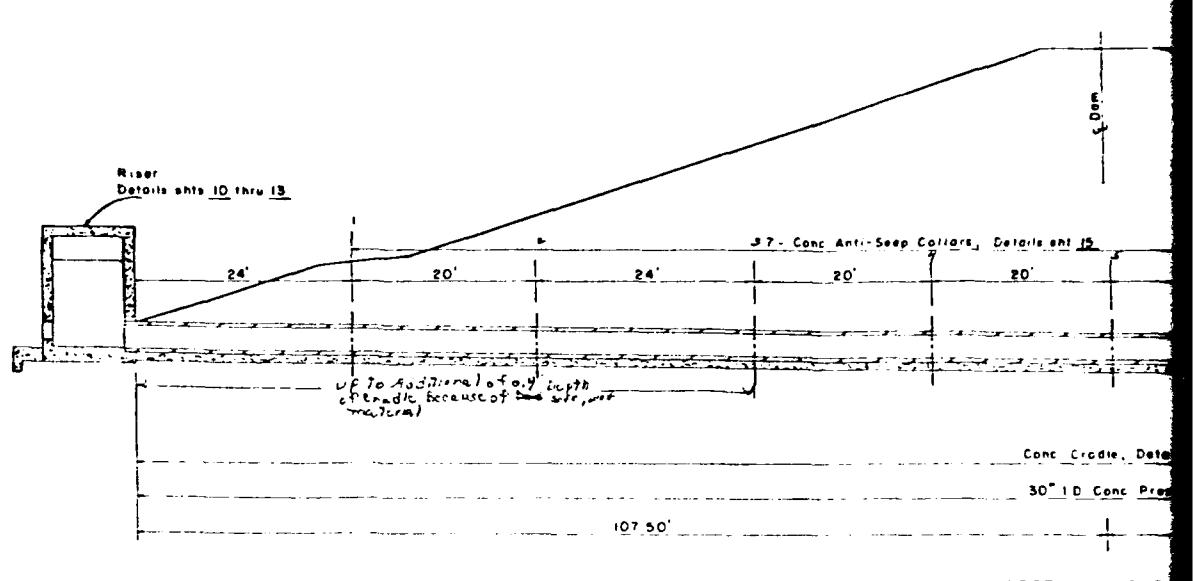
U. S. DEPARTMENT OF AGRICULTURE  
SOIL CONSERVATION SERVICE

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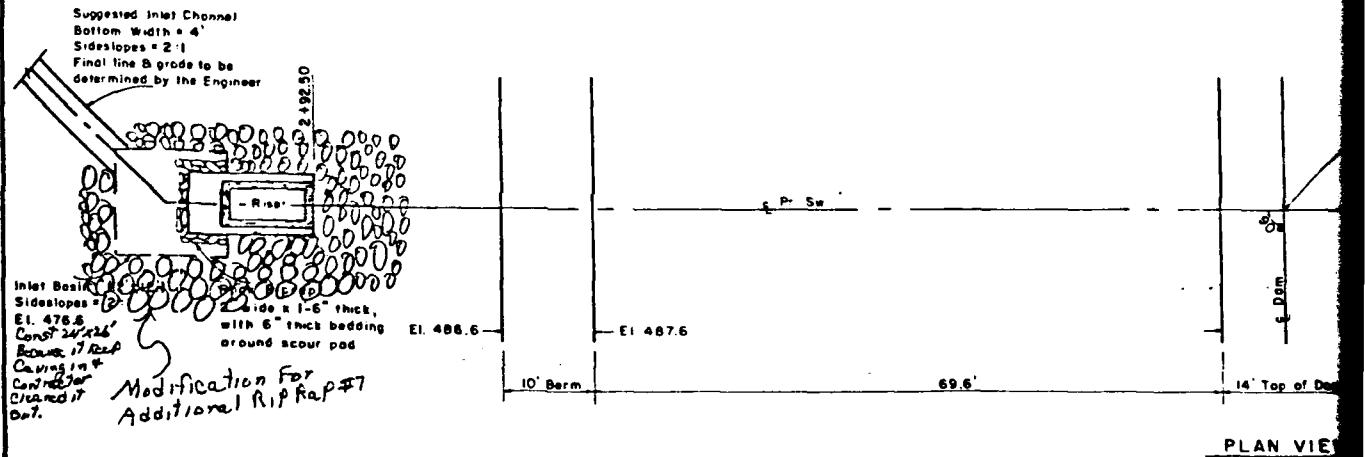
PA-433-P

SECTION E-E

PLATE 6



Digitized by srujanika@gmail.com



PLAN VIEW

AS BUILT  
30° LD. PIPE JOINT DATA

JOINT	DIST. FROM RISER WALL	INVERT EL.
J-12	70.53	479.64
J-11	60.33	479.50
J-10	50.33	479.56
J-9	40.33	479.71
J-8	10.33	479.71
J-7	10.33	479.71
J-6	10.33	479.18
J-5	100.33	479.91
J-4	80.33	479.91
J-3	60.33	479.91
J-2	50.33	479.91
J-1	30.33	479.91
		479.91

AS BUILT  
30° ID COLLAR DATA

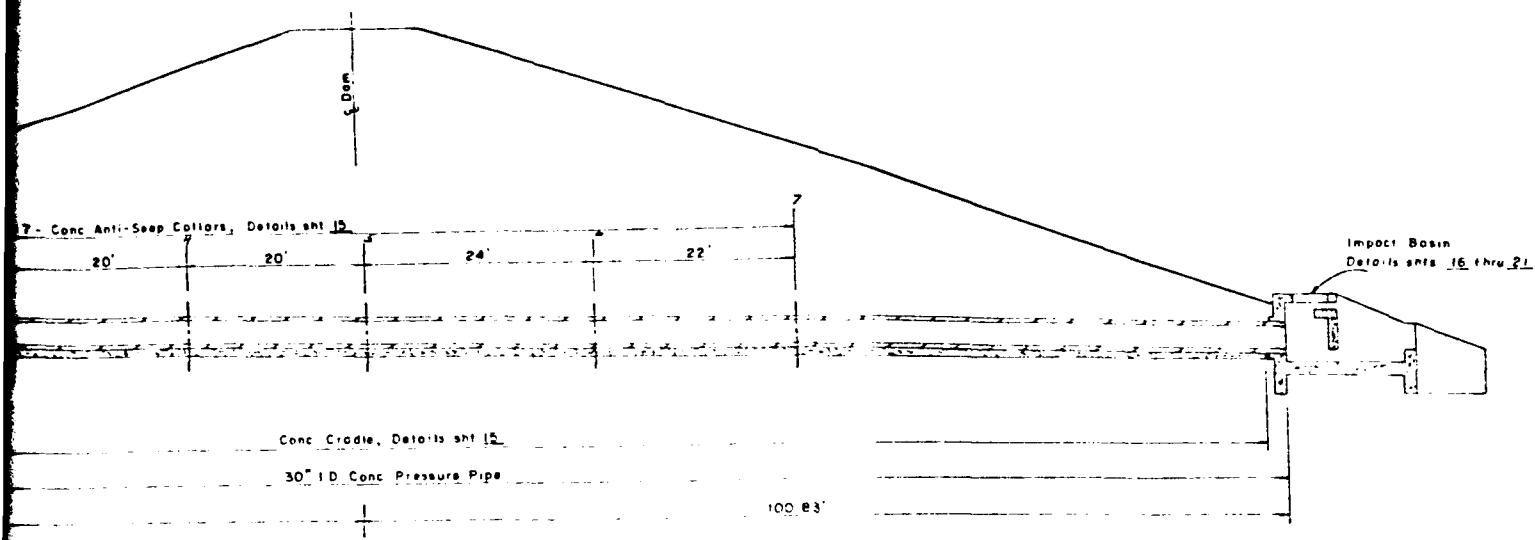
COLLAR	DIST. FROM RISER WALL	INVERT EL.
1	24	472.48
2	44	472.32
3	48	472.24
4	68	472.16
5	108	472.08
6	122	472.18
7	156	472.28

**30" I.D. Reinforced Concrete Pressure Pipe, Steel Cylinder Type  
Spec. 541 (AWWA C-300 or C-301)**

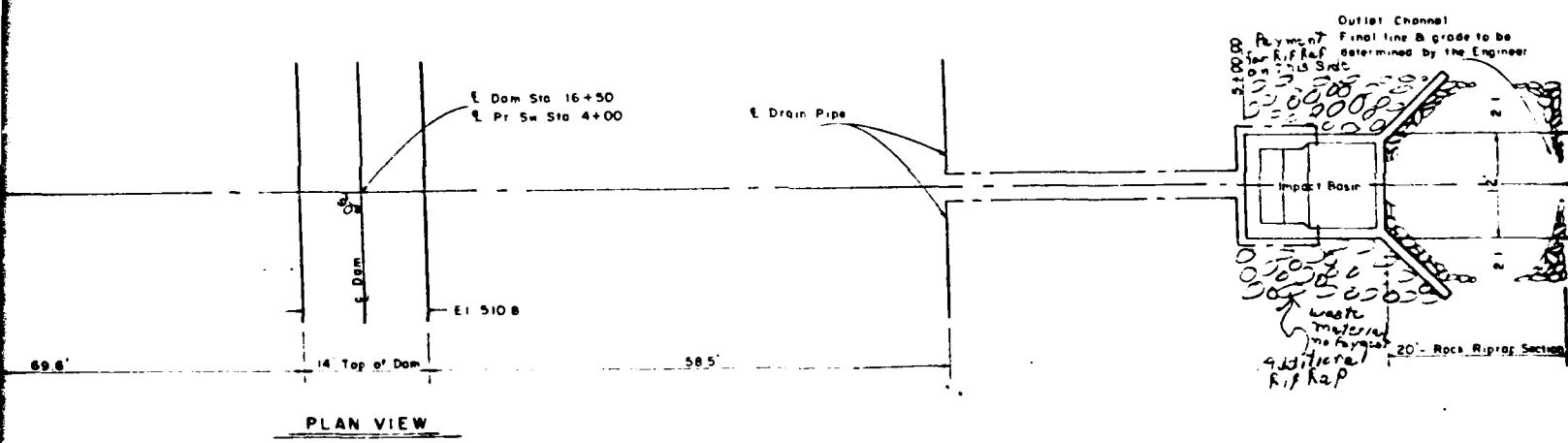
## 208' - Straight Sections

## 1 - Spigot Wall Fitting (For 10° Wall)

208' - Total



PROFILE ALONG E PR SW



**PLAN VIEW**

**Reinforced Concrete Pressure Pipe, Steel Cylinder Type  
2.341 (AWWA C-300 or C-301)**

- Straight Sections
- Spigot Wall Fitting (For 10° Wall)
- Total

### CONSTRUCTION NOTES

1. Outlet end of pipe to be finished so that no metal is exposed
2. Pipe layout data to be furnished by the Engineer
3. Riprap bedding shall meet fine drain fill gradation limits (sht. 7)

## BRANDYWINE CREEK WATERSHED

FLOODWATER RETARDING DAM PA-433  
CHESTER COUNTY, PENNSYLVANIA

## PRINCIPAL SPILLWAY

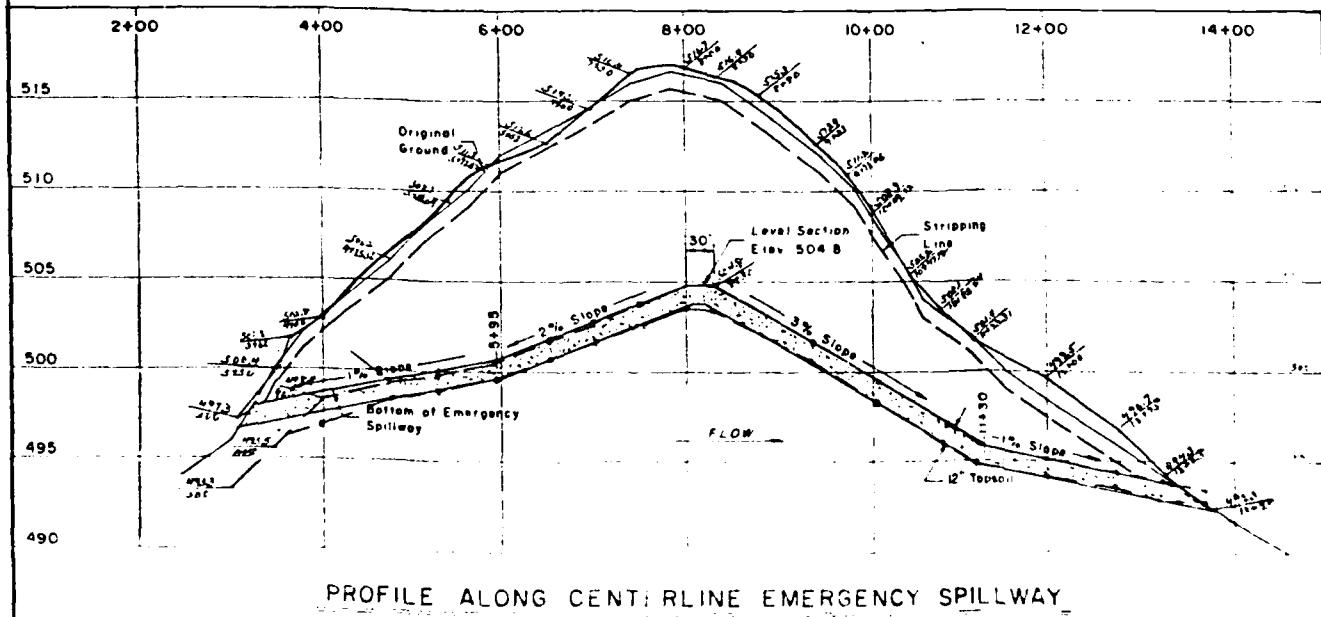
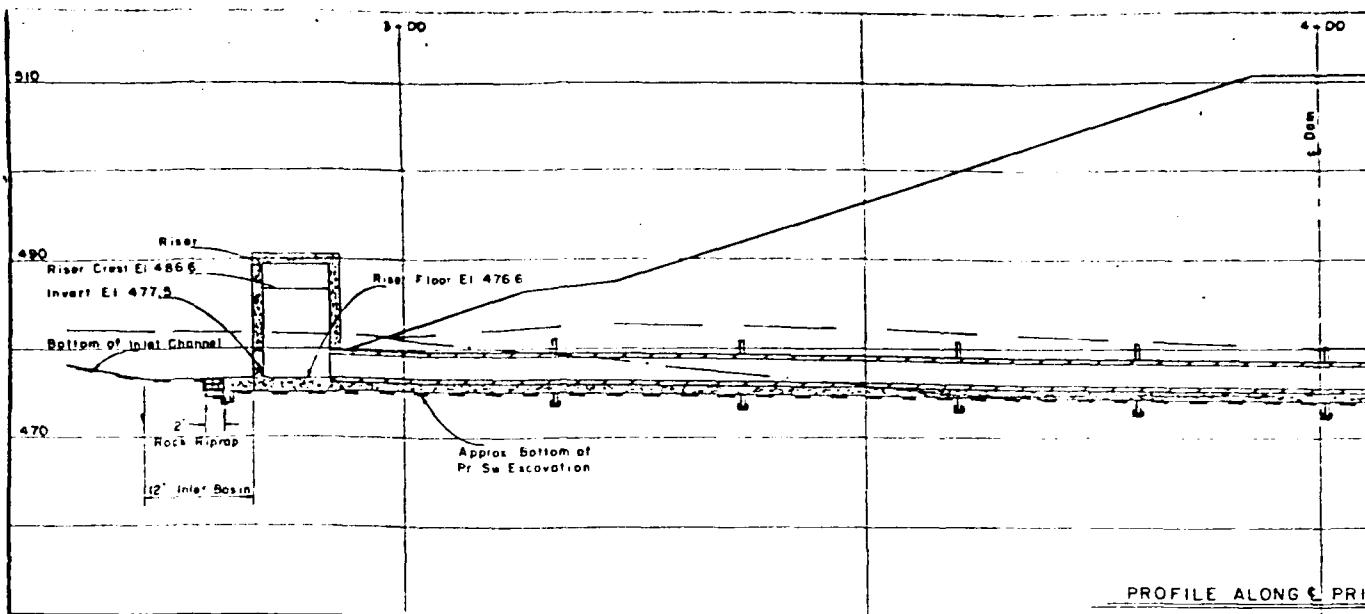
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SOIL CONSERVATION SERVICE

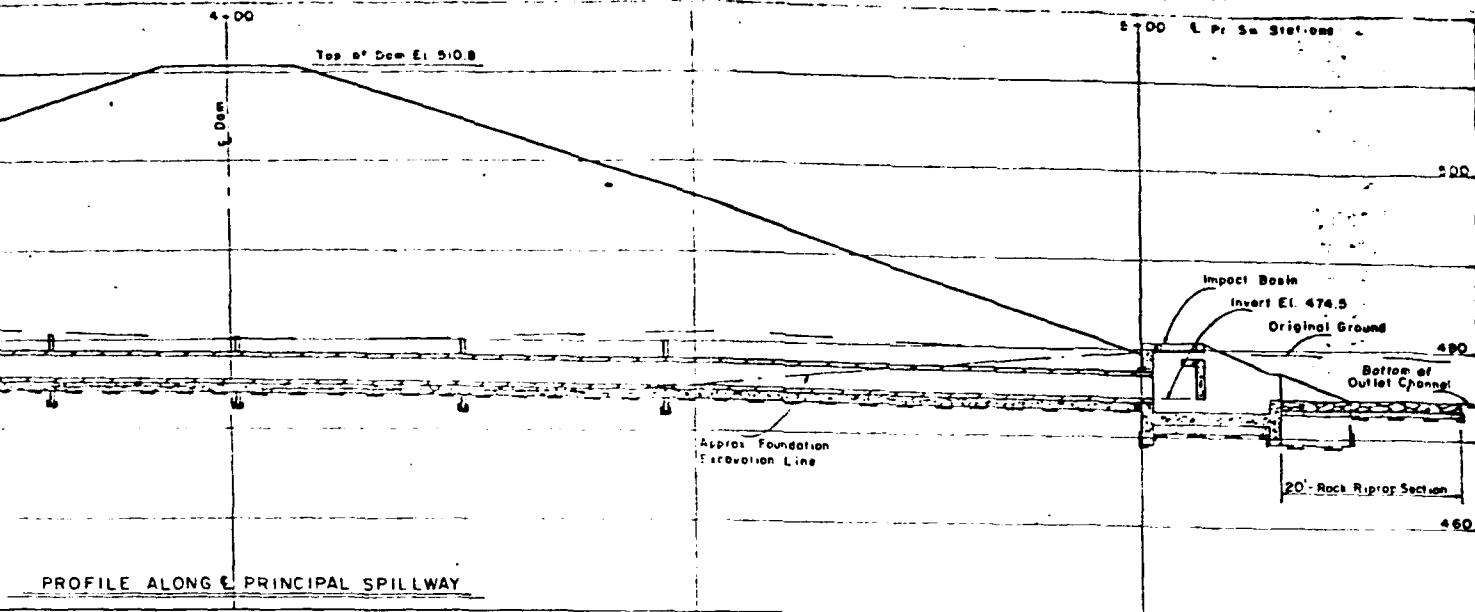
PLATE 7

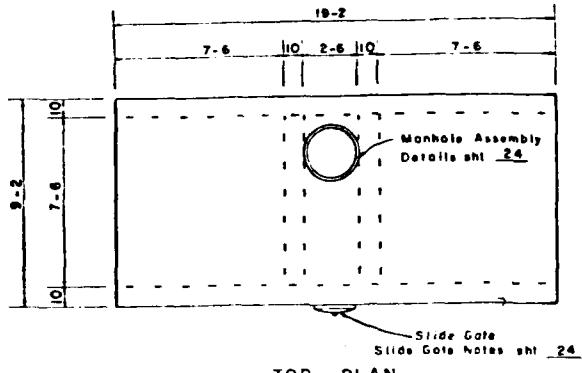
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PA-433-P

SCS ENG-313-B 14

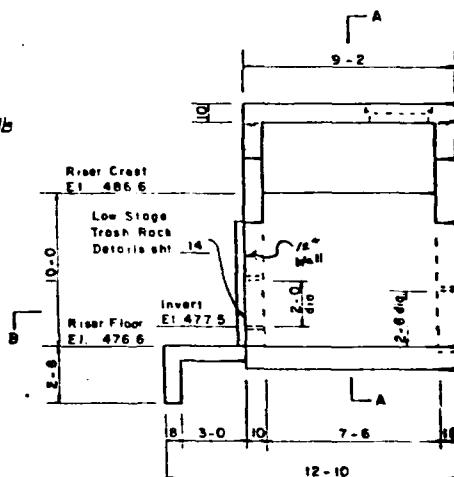
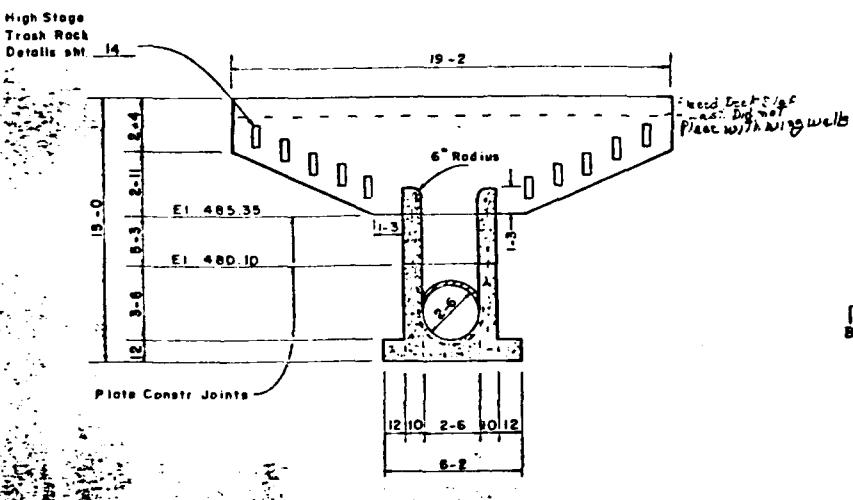
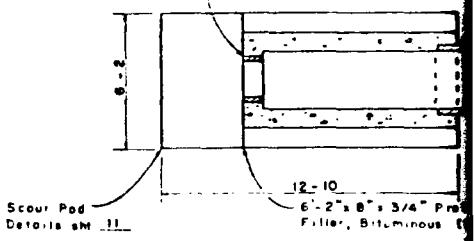






24" Dia  
Wall Thimble, Type E,  
12-40" Deep (drill B top to  
accommodate gate)

Sp. Det.  
Details

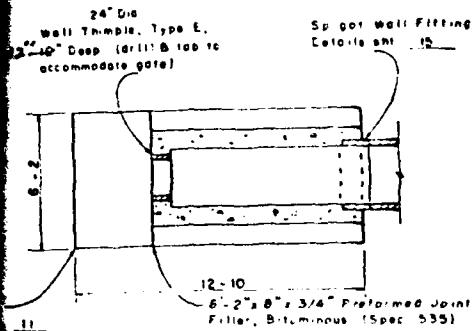


2-1/2" x 6" CARBON STEEL PLATE  
TO CONFORM TO SPEC. SEC. 2  
CONTINUOUS TYPE CONCRETE JOINT.  
SPLICES SHALL BE EITHER:  
1. BUTT WELDED  
2. LAPPED 3" AND SPLICED  
3. LAPPED 3" AND VELMET WELDED

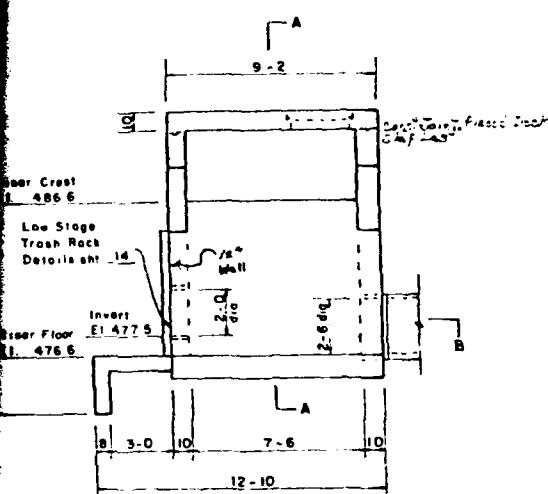
PLATE CONSTR. JOINT

CONSTRUCTION NOTES

1. PORTLAND CEMENT TYPE I-A OR I WITH AN  
ALL-EXTRACTING ADMIXTURE SHALL BE USED.
2. WHEN NOT OTHERWISE STATED THE CEMENTS OF  
CONCRETE OVER REINFORCED STEEL SHALL BE  
OF IT FUSED SURFACES AND IN REINFORCED  
SURFACES OF THE CONCRETE.
3. ALL EXPOSED EDGES OF CONCRETE SO HAVE A  
CHAMFER, UNLESS OTHERWISE STATED.
4. ALL DIMENSIONS ARE IN FEET TO NEAREST HALF



SECTION B-B

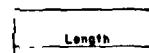


SIDE ELEVATION

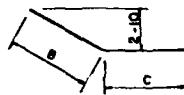
STEEL SCHEDULE

NAME	SIZE	QUANTITY	LENGTH	TYPE	B	C	TOTAL LENGTH
R1	5	10	6'-0	1			57'-6
R2	4	12	6'-0	21	1'-0	5'-9	61'-0
R3	6	6	6'-0	1			57'-6
R4	5	1	6'-0	1			52'-6
R5	5	9	6'-0	1			52'-6
R6	5	2	6'-0	1			52'-6
R7	5	5	6'-0	1			52'-6
R8	5	2	6'-0	20	1'-0	5'-9	57'-6
R9	5	2	6'-0	21	1'-0	5'-9	57'-6
R10	5	8	6'-0	21	1'-0	5'-9	57'-6
R11	5	6	3'-0	1			44'-0
R12	5	3	2'-3	1			13'-0
R13	5	3	2'-3	1			13'-0
R14	5	1	2'-3	1			6'-9
R15	5	1	2'-3	20	0'-6	5'-3	16'-0
R16	5	1	2'-3	21	2'-0	5'-3	16'-0
R17	5	1	2'-3	21	2'-0	3'-0	15'-0
R18	7	6	4'-0	1			3'-6
R19	5	8	3'-0	1			21'-0
							24'-0
R1	5	12	6'-0	1			72'-0
R2	5	8	7'-0	2			56'-0
R3	5	16	6'-3	2			132'-0
R4	5	16	3'-3	2			92'-0
R5	5	10	7'-0	2			70'-0
R6	5	16	8'-0	20	2'-3	5'-3	288'-0
R7	5	12	6'-3	1			75'-0
R8	5	8	7'-0	2			56'-0
R9	5	12	12'-6	1			50'-0
R10	5	6	10'-0	1			72'-0
R11	5	6	10'-9	1			75'-0
R12	5	6	8'-0	19	6'-3	1'-9	66'-0
R13	5	6	8'-0	2			20'-0
R14	5	6	9'-6	2			30'-0
R15	5	6	9'-6	2			30'-0
R16	5	16	6'-0	1			30'-0
R17	5	6	6'-0	2			30'-0
R18	5	22	8'-9	2			32'-0
R19	5	1	6'-0	2			32'-0
R20	5	5	10'-3	2			30'-0
R21	5	22	11'-3	2			225'-0
R22	5	6	7'-9	1			62'-0

①



②



③



BAR TYPES

QUANTITIES

CONCRETE Class 4000 (riser only) 19.5 cu yds

STEEL

no. 5 bars	2615.5	=	2720	lbs.
no. 7 bars	161.5	=	371	lbs.
Total	3099			lbs.

AS BUILT

NOT TO SCALE

BRANDYWINE CREEK WATERSHED

FLOODWATER RETARDING DAM PA-433  
CHESTER COUNTY, PENNSYLVANIA

RISER

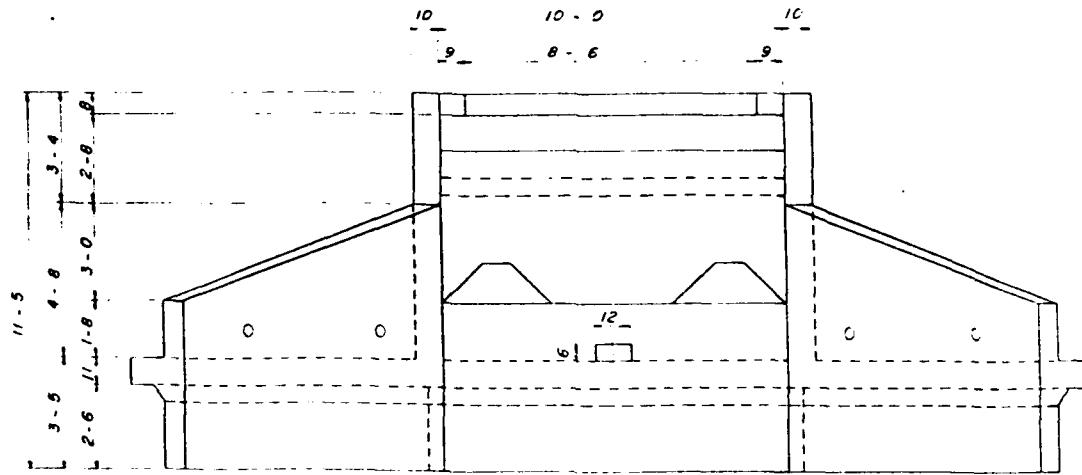
U. S. DEPARTMENT OF AGRICULTURE  
SOIL CONSERVATION SERVICE

PLATE 9

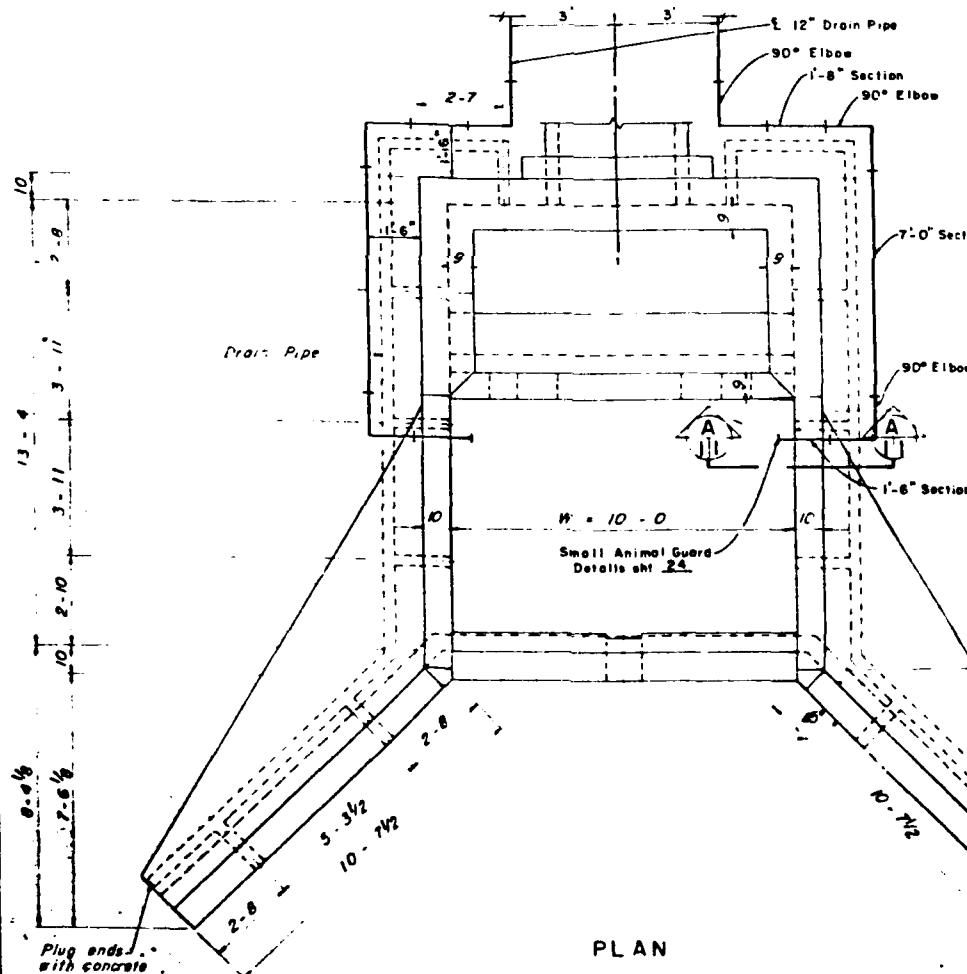
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PA-433-P

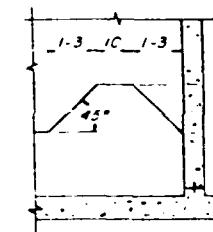
DEC 31 1974 LATRI



DOWNSTREAM ELEVATION



SECTION  
NOT TO SCALE



PLAN - SECTION  
SIDEWALL AND  
WINGWALL  
NOT TO SCALE

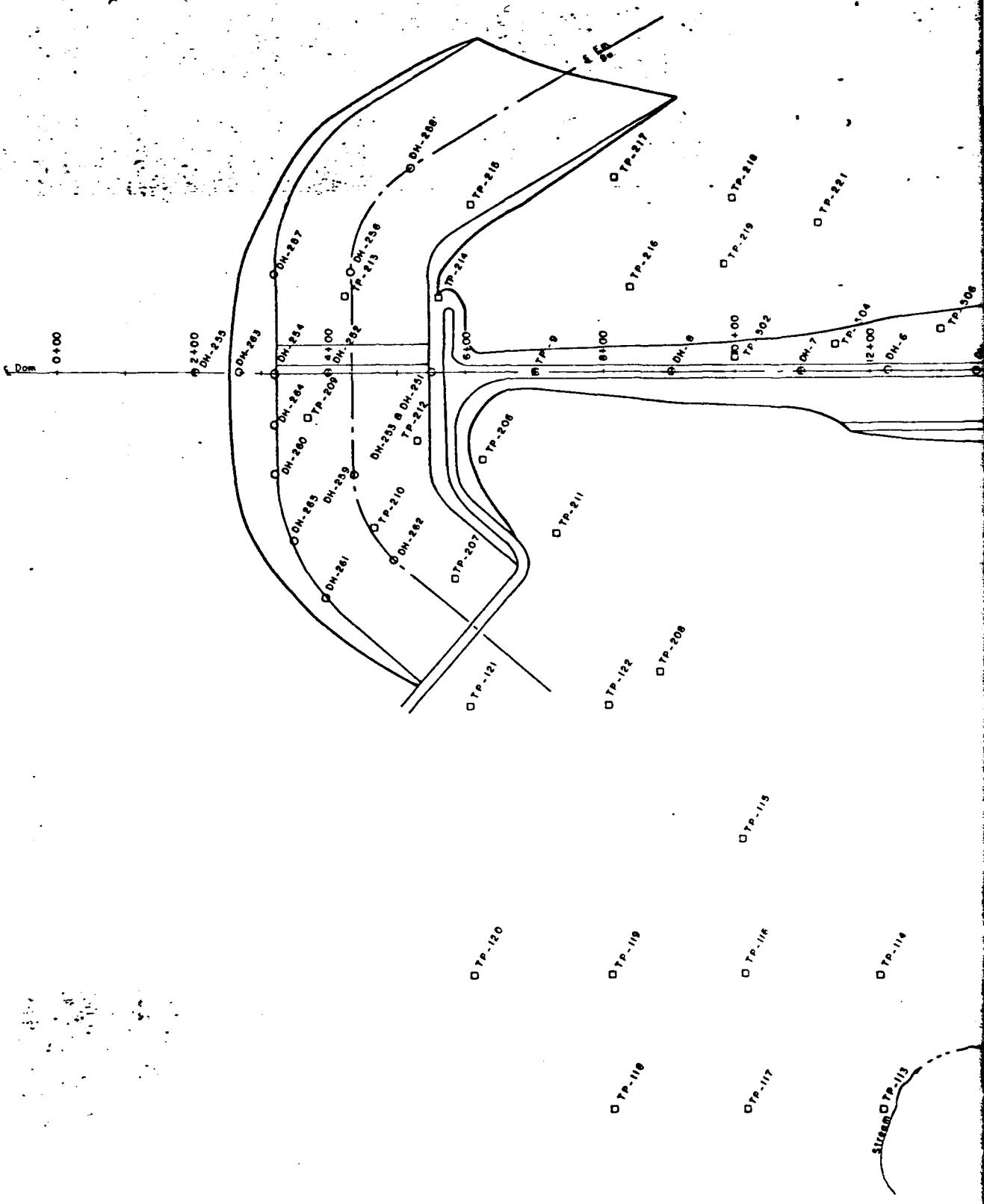
## PLAN

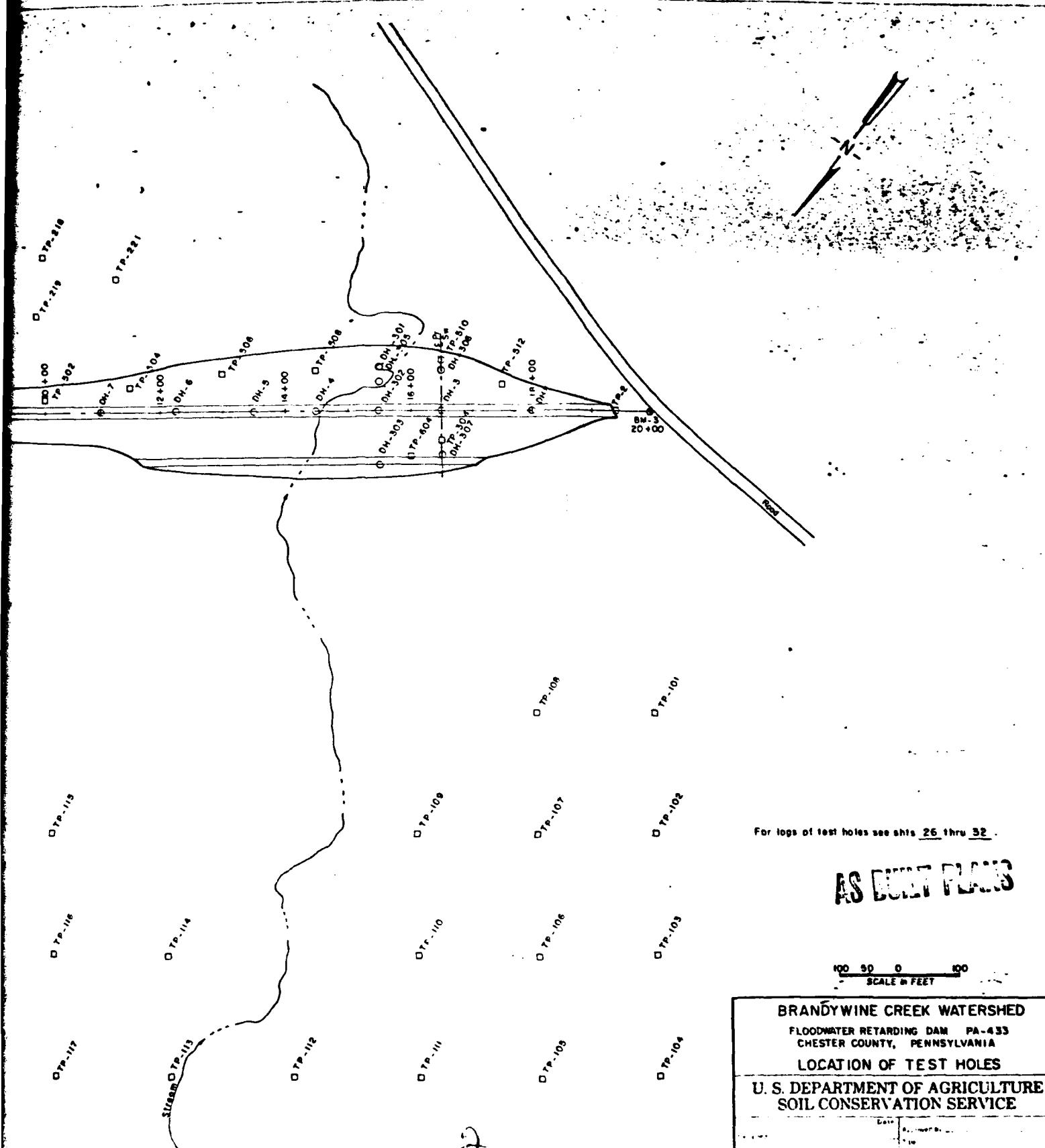
STANDARD IMPACT BASIN	
DESIGN CONSTANTS	$f_1 = 4,000 \text{ ps}$
	$f_2 = 160 \text{ ps}$
	$R = 8$
	$f_3 = 20,000 \text{ ps}$
STANDARD DRAWING NO. ES-4100	
DATE 1-70	SHEET 1 OF 5

CARL ROMDE  
Consulting Engineer  
554 Ridgeway Rd. Los Angeles, Ore.

10  
SCALE IN FEET  
EXCEPT AS NOTED







BRANDYWINE CREEK WATERSHED	
FLOODWATER RETARDING DAM PA-433	
CHESTER COUNTY, PENNSYLVANIA	
LOCATION OF TEST HOLES	
U. S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE	
DATE	8-1-64
CHISE	1-74
LAND FARM	3-74
PA-433-P	33

PLATE 11

TEST HOLE 3-22-72  
LOGGED BY R. C. FREAS  
DRILLING EQUIPMENT - S.A. HAMMER, 300 LB.

HOLE DEPTH FROM	TO	DESCRIPTION OF MATERIALS	SYMB.	UNIF. SOIL CLASS	STANDARD PENETRATION TYPE B12 BLOWS PER IN.	FROM IN.	TO IN.	TYPE B12 IN.	FROM IN.	TO IN.	TYPE B12 IN.	REL.		
0.0	0.7	TOPSOIL - DEEP, BROWN, ETC.												
0.7	3.5	SILT, SANDY - ORANGE, BROWN, MOIST, VERY SLIGHTLY PLASTIC, SOFT, TO FIRM, TRACE GRAVEL, 30 PERCENT SAND, 70 PERCENT FINES, SAND = 10% FINE, GRAVEL, SAND CONTENT VARIABLE, WITH SAND 40 PERCENT.	ML	2-2-3	SPT	2	44	0.0	3.5	0.0	0.0	0.0		
3.5	6.0	SAND, SILTY - ORANGE, 30 PERCENT, MICACEOUS, NONPLASTIC, FIRM, MOIST, 10% GRAVEL, 35 PERCENT SAND, 35 PERCENT FINES, LOCALLY ONLY 10% FINES.	SM	12-22-36	SPT	2	44	0.0	6.0	0.0	0.0	0.0		
6.0	18.0	SAPROLITE - TAN TO WHITE, BANDED, MOIST, NONPLASTIC, LOCALLY FINES, 35 PERCENT GRAVEL, 30 PERCENT SAND, 25 PERCENT FINES, LOCALLY FINES ONLY 15 PERCENT, BECOMES NOTABLY MORE FIRM WITH DEPTH.	SM	30-22-32-56	SPT	2	44	0.0	7.5	0.0	0.0	0.0		
18.0	20.5	6.0 BELOW 18.0 HAS TO USE 300 LB HAMMER.		55-125	DIA	9	JAR	16.0	17.0	0.0	0.0	0.0		
20.5	28.5	QUARTZ MONZONITE - WHITE TO TAN, GRAY WITH DRY & GREENISH GREY STREAKS, HIGHLY WEAK, AGGRA - ALMOST STANDING STONE, FRAGILE WITH HARD & SOFT LAYERS, WEST SIDE APPEARS, SAME TO GRAVEL, WITH LARGER FRAGMENTS DUE TO DRYING.			DIA	9	JAR	17.0	19.0	0.0	0.0	0.0		
28.5		BOTTOM OF HOLE, WL (3-22-72) 28.5 FT.										23.0	26.5	0.0

W/300 LB. HAMMER USED

TEST ELEV. 512.0, 100% CENTER, INC  
LOGGED BY R. C. FREAS 3-22-72  
DRILLING EQUIPMENT - JOHN DEERE BACKHOE

HOLE DEPTH FROM	TO	DESCRIPTION OF MATERIALS	SYMB.	UNIF. SOIL CLASS	STANDARD PENETRATION TYPE B12 BLOWS PER IN.	FROM IN.	TO IN.	TYPE B12 IN.	FROM IN.	TO IN.	TYPE B12 IN.	REL.
0.0	0.9	TOPSOIL - BLACK, BROWN, ETC.										
0.9	4.7	SILT, SANDY - ORANGE TO TAN, MOIST, VERY SLIGHTLY PLASTIC, TRACE GRAVEL 30 PERCENT SAND, 70 PERCENT FINES, SAND CONTENT SLIGHTLY VARIABLE, USES UP TO 45 PERCENT.	ML	10-28-46	SPT	2	44	0.0	4.0	0.0	0.0	0.0
4.7	7.0	SAND, SILTY - LT. TAN, VERY SLIGHTLY MOIST, NONPLASTIC, MICACEOUS, 5 PERCENT GRAVEL, 65 PERCENT FINE SAND, 30 PERCENT FINES.	SM	12-24-20	SPT	2	44	0.0	7.0	0.0	0.0	0.0
7.0	9.6	SAND, SILTY - VERY LT. TAN WITH WHITE TO GREY, VERY SLIGHTLY MOIST, NONPLASTIC, 5 PERCENT LARGER THAN 30%, WHICH IS 30 PERCENT GRAVEL, 50 PERCENT FINE SAND, 20 PERCENT FINES, THIS IS RESIDUAL OVER QUARTZ ZONITE, REFUSED AT 9.6 FT.	SM	20-30-46	SPT	2	44	0.0	9.5	0.0	0.0	0.0
9.6		BOTTOM OF HOLE, DRY										

DM-3, ELEV. 460.0, 200% CENTERLINE  
LOGGED BY R. C. FREAS 3-23-72  
DRILLING EQUIPMENT - S.A. HAMMER, 300 LB.

HOLE DEPTH FROM	TO	DESCRIPTION OF MATERIALS	SYMB.	UNIF. SOIL CLASS	STANDARD PENETRATION TYPE B12 BLOWS PER IN.	FROM IN.	TO IN.	TYPE B12 IN.	FROM IN.	TO IN.	TYPE B12 IN.	REL.
0.0	2.0	SILT - LT. TO MEDIUM, GRAY WITH RUST & BECOMING TAN TO GREY BELOW 2 FT., MOTTLED, VERY SOFT, NONPLASTIC, HUMIC ODE.	ML	1-2	SPT	2	JAR	0.0	2.5	0.0	0.0	0.0
2.0	3.1	SILT, SANDY, ORGANIC - LT. GREY TO BLACK, VERY SOFT, NONPLASTIC, 25 PERCENT FINE SAND, 75 PERCENT FINES, CONTAINS ABOUT 15 PERCENT ORGANIC MATERIAL.	ML	10-46-58	SPT	2	44	0.0	5.5	0.0	0.0	0.0
3.1	3.9	GRAVEL, SANDY - LT. TAN, WET, FIRM, NONPLASTIC, 55 PERCENT GRAVEL, 30 PERCENT SAND, 15 PERCENT FINES, GRAVEL IS FINE GRAINED, SUBANGULAR TO SURROUNDED, ALLUVIAL.	SM	20-24-20	SPT	2	44	0.0	5.5	0.0	0.0	0.0
3.9	10.0	SAPROLITE - TAN, GREY & WHITE WITH OR GREY & GREENISH GREY BANDS, 100% HAMMER BELOW 14 FEET, WEAK, TO 8 FT. WITH MED., TO COARSE SAND, WEAK TO PLACE FROM QUARTZ MONZONITE, THIS MATERIAL IS VERY SOLID & ALMOST IMPOSSIBLE TO SAMPLE WITH SPT, TOO DECOMPOSED TO DRILL.	SM	30-30-105	SPT	2	44	0.0	10.0	0.0	0.0	0.0
10.0	16.0	QUARTZ MONZONITE - LT. GREY TO WHITE WITH OR GREY & GREENISH GREY BANDS, 100% HAMMER BELOW 14 FEET, WEAK, TO 8 FT. WITH MED., TO COARSE SAND, WEAK TO PLACE FROM QUARTZ MONZONITE, THIS MATERIAL IS VERY SOLID & ALMOST IMPOSSIBLE TO SAMPLE WITH SPT, TOO DECOMPOSED TO DRILL.	SM	30-46-52-68	SPT	2	44	0.0	12.0	0.0	0.0	0.0
16.0	20.0	30-46-52-68 TO 16.0 FT. QUARTZ MONZONITE - LT. GREY TO WHITE WITH OR GREY & GREENISH GREY BANDS, 100% HAMMER BELOW 14 FEET, WEAK, TO 8 FT. WITH MED., TO COARSE SAND, WEAK TO PLACE FROM QUARTZ MONZONITE, THIS MATERIAL IS VERY SOLID & ALMOST IMPOSSIBLE TO SAMPLE WITH SPT, TOO DECOMPOSED TO DRILL.	SM	20-34-48-66	SPT	2	44	0.0	14.0	0.0	0.0	0.0
20.0	30.0	30-30-105 TO 20.0 FT. QUARTZ MONZONITE - LT. GREY TO WHITE WITH OR GREY & GREENISH GREY BANDS, 100% HAMMER BELOW 14 FEET, WEAK, TO 8 FT. WITH MED., TO COARSE SAND, WEAK TO PLACE FROM QUARTZ MONZONITE, THIS MATERIAL IS VERY SOLID & ALMOST IMPOSSIBLE TO SAMPLE WITH SPT, TOO DECOMPOSED TO DRILL.	SM	30-30-105	SPT	2	44	0.0	16.0	0.0	0.0	0.0
30.0	36.0	30-30-105 TO 30.0 FT. QUARTZ MONZONITE - LT. GREY TO WHITE WITH OR GREY & GREENISH GREY BANDS, 100% HAMMER BELOW 14 FEET, WEAK, TO 8 FT. WITH MED., TO COARSE SAND, WEAK TO PLACE FROM QUARTZ MONZONITE, THIS MATERIAL IS VERY SOLID & ALMOST IMPOSSIBLE TO SAMPLE WITH SPT, TOO DECOMPOSED TO DRILL.	SM	30-30-105	SPT	2	44	0.0	18.0	0.0	0.0	0.0
36.0		BOTTOM OF HOLE, WL (3-23-72) 36.0 FT.										

ON-3, ELEV. 481.0, 14-50, CENTERLINE  
LOGGED BY R. C. FREAS 3-23-72  
DRILLING EQUIPMENT - S.A. HAMMER, 300 LB.

HOLE DEPTH FROM	TO	DESCRIPTION OF MATERIALS	SYMB.	UNIF. SOIL CLASS	STANDARD PENETRATION TYPE B12 BLOWS PER IN.	FROM IN.	TO IN.	TYPE B12 IN.	FROM IN.	TO IN.	TYPE B12 IN.	REL.
0.0	1.5	TOPSOIL - BROWN, ETC.										
1.5	8.0	SILT, SANDY - TAN BECOMING GREY WITH RUST, MOTTLED, MOIST, VERY SLIGHTLY PLASTIC, SOFT, SLIGHTLY HUMIC ODE, SOME ORGANIC MATERIAL PRESENT, 20 PERCENT SAND, 80 PERCENT FINES BECOMING 45 PERCENT SAND.	ML	3-2-1-2	SPT	2	JAR	0.0	2.0	0.0	0.0	0.0
8.0	11.5	35 PERCENT FINES, GRAVEL, SANDY - LT. GREY WITH OR GREY & WHITE, WEAK, FIRM, NONPLASTIC, VERY POORELY GRAVEL, 30 PERCENT SAND, 20 PERCENT FINES.	SM	9-21-40	SPT	2	44	0.0	3.5	0.0	0.0	0.0
11.5	13.5	35 PERCENT FINES, GRAVEL, SANDY - LT. GREY WITH OR GREY & WHITE, WEAK, FIRM, NONPLASTIC, VERY POORELY GRAVEL, 30 PERCENT SAND, 20 PERCENT FINES.	SM	9-21-40	SPT	2	44	0.0	5.0	0.0	0.0	0.0
13.5	15.5	35 PERCENT FINES, GRAVEL, SANDY - LT. GREY WITH OR GREY & WHITE, WEAK, FIRM, NONPLASTIC, VERY POORELY GRAVEL, 30 PERCENT SAND, 20 PERCENT FINES.	SM	9-21-40	SPT	2	44	0.0	6.5	0.0	0.0	0.0
15.5	17.5	35 PERCENT FINES, GRAVEL, SANDY - LT. GREY WITH OR GREY & WHITE, WEAK, FIRM, NONPLASTIC, VERY POORELY GRAVEL, 30 PERCENT SAND, 20 PERCENT FINES.	SM	9-21-40	SPT	2	44	0.0	8.0	0.0	0.0	0.0
17.5	20.0	35 PERCENT FINES, GRAVEL, SANDY - LT. GREY WITH OR GREY & WHITE, WEAK, FIRM, NONPLASTIC, VERY POORELY GRAVEL, 30 PERCENT SAND, 20 PERCENT FINES.	SM	9-21-40	SPT	2	44	0.0	9.5	0.0	0.0	0.0
20.0	22.0	35 PERCENT FINES, GRAVEL, SANDY - LT. GREY WITH OR GREY & WHITE, WEAK, FIRM, NONPLASTIC, VERY POORELY GRAVEL, 30 PERCENT SAND, 20 PERCENT FINES.	SM	9-21-40	SPT	2	44	0.0	11.0	0.0	0.0	0.0
22.0	24.0	35 PERCENT FINES, GRAVEL, SANDY - LT. GREY WITH OR GREY & WHITE, WEAK, FIRM, NONPLASTIC, VERY POORELY GRAVEL, 30 PERCENT SAND, 20 PERCENT FINES.	SM	9-21-40	SPT	2	44	0.0	12.5	0.0	0.0	0.0
24.0	26.0	35 PERCENT FINES, GRAVEL, SANDY - LT. GREY WITH OR GREY & WHITE, WEAK, FIRM, NONPLASTIC, VERY POORELY GRAVEL, 30 PERCENT SAND, 20 PERCENT FINES.	SM	9-21-40	SPT	2	44	0.0	14.0	0.0	0.0	0.0
26.0	28.0	35 PERCENT FINES, GRAVEL, SANDY - LT. GREY WITH OR GREY & WHITE, WEAK, FIRM, NONPLASTIC, VERY POORELY GRAVEL, 30 PERCENT SAND, 20 PERCENT FINES.	SM	9-21-40	SPT	2	44	0.0	15.5	0.0	0.0	0.0
28.0	30.0	35 PERCENT FINES, GRAVEL, SANDY - LT. GREY WITH OR GREY & WHITE, WEAK, FIRM, NONPLASTIC, VERY POORELY GRAVEL, 30 PERCENT SAND, 20 PERCENT FINES.	SM	9-21-40	SPT	2	44	0.0	17.0	0.0	0.0	0.0
30.0	32.0	35 PERCENT FINES, GRAVEL, SANDY - LT. GREY WITH OR GREY & WHITE, WEAK, FIRM, NONPLASTIC, VERY POORELY GRAVEL, 30 PERCENT SAND, 20 PERCENT FINES.	SM	9-21-40	SPT	2	44	0.0	18.5	0.0	0.0	0.0
32.0	34.0	35 PERCENT FINES, GRAVEL, SANDY - LT. GREY WITH OR GREY & WHITE, WEAK, FIRM, NONPLASTIC, VERY POORELY GRAVEL, 30 PERCENT SAND, 20 PERCENT FINES.	SM	9-21-40	SPT	2	44	0.0	20.0	0.0	0.0	0.0
34.0	36.0	35 PERCENT FINES, GRAVEL, SANDY - LT. GREY WITH OR GREY & WHITE, WEAK, FIRM, NONPLASTIC, VERY POORELY GRAVEL, 30 PERCENT SAND, 20 PERCENT FINES.	SM	9-21-40	SPT	2	44	0.0	21.5	0.0	0.0	0.0
36.0	38.0	35 PERCENT FINES, GRAVEL, SANDY - LT. GREY WITH OR GREY & WHITE, WEAK, FIRM, NONPLASTIC, VERY POORELY GRAVEL, 30 PERCENT SAND, 20 PERCENT FINES.	SM	9-21-40	SPT	2	44	0.0	23.0	0.0	0.0	0.0
38.0	40.0	35 PERCENT FINES, GRAVEL, SANDY - LT. GREY WITH OR GREY & WHITE, WEAK, FIRM, NONPLASTIC, VERY POORELY GRAVEL, 30 PERCENT SAND, 20 PERCENT FINES.	SM	9-21-40	SPT	2	44	0.0	24.5	0.0	0.0	0.0
40.0	42.0	35 PERCENT FINES, GRAVEL, SANDY - LT. GREY WITH OR GREY & WHITE, WEAK, FIRM, NONPLASTIC, VERY POORELY GRAVEL, 30 PERCENT SAND, 20 PERCENT FINES.	SM	9-21-40	SPT	2	44	0.0	26.0	0.0	0.0	0.0
42.0	44.0	35 PERCENT FINES, GRAVEL, SANDY - LT. GREY WITH OR GREY & WHITE, WEAK, FIRM, NONPLASTIC, VERY POORELY GRAVEL, 30 PERCENT SAND, 20 PERCENT FINES.	SM	9-21-40	SPT	2	44	0.0	27.5	0.0	0.0	0.0
44.0	46.0	35 PERCENT FINES, GRAVEL, SANDY - LT. GREY WITH OR GREY & WHITE, WEAK, FIRM, NONPLASTIC, VERY POORELY GRAVEL, 30 PERCENT SAND, 20 PERCENT FINES.	SM	9-21-40	SPT	2	44	0.0	29.0	0.0	0.0	0.0
46.0	48.0	35 PERCENT FINES, GRAVEL, SANDY - LT. GREY WITH OR GREY & WHITE, WEAK, FIRM, NONPLASTIC, VERY POORELY GRAVEL, 30 PERCENT SAND, 20 PERCENT FINES.	SM	9-21-40	SPT	2	44	0.0	30.5	0.0	0.0	0.0
48.0	50.0	35 PERCENT FINES, GRAVEL, SANDY - LT. GREY WITH OR GREY & WHITE, WEAK, FIRM, NONPLASTIC, VERY POORELY GRAVEL, 30 PERCENT SAND, 20 PERCENT FINES.	SM	9-21-40	SPT	2	44	0.0	32.0	0.0	0.0	0.0
50.0	52.0	35 PERCENT FINES, GRAVEL, SANDY - LT. GREY WITH OR GREY & WHITE, WEAK, FIRM, NONPLASTIC, VERY POORELY GRAVEL, 30 PERCENT SAND, 20 PERCENT FINES.	SM	9-21-40	SPT	2	44	0.0	33.5	0.0	0.0	0.0
52.0	54.0	35 PERCENT FINES, GRAVEL, SANDY - LT. GREY WITH OR GREY & WHITE, WEAK, FIRM, NONPLASTIC, VERY POORELY GRAVEL, 30 PERCENT SAND, 20 PERCENT FINES.	SM	9-21-40	SPT	2	44	0.0	35.0	0.0	0.0	0.0
54.0	56.0	35 PERCENT FINES, GRAVEL, SANDY - LT. GREY WITH OR GREY & WHITE, WEAK, FIRM, NONPLASTIC, VERY POORELY GRAVEL, 30 PERCENT SAND, 20 PERCENT FINES.	SM	9-21-40	SPT	2	44	0.0	36.5	0.0	0.0	0.0
56.0	58.0	35 PERCENT FINES, GRAVEL, SANDY - LT. GREY WITH OR GREY & WHITE, WEAK, FIRM, NONPLASTIC, VERY POORELY GRAVEL, 30 PERCENT SAND, 20 PERCENT FINES.	SM	9-21-40	SPT	2	44	0.0	38.0	0.0	0.0	0.0
58.0	60.0	35 PERCENT FINES, GRAVEL, SANDY - LT. GREY WITH OR GREY & WHITE, WEAK, FIRM, NONPLASTIC, VERY POORELY GRAVEL, 30 PERCENT SAND, 20 PERCENT FINES.	SM	9-21-40	SPT	2						



### LEGEND

#### TEST HOLE NUMBERING SYSTEM

Centerline of Dam	1 - 99
Borrow area	101 - 199
Emergency spillway	201 - 299
Centerline of outlet structure	301 - 399
Stream channel	401 - 499
Relief wells	501 - 599
	601 - 699
	701 - 799

#### UNIFIED SOIL CLASSIFICATION SYSTEM SYMBOLS

GW	Well graded gravels; gravel-sand mixtures
GP	Poorly graded gravels
GM	Silty gravels; gravel-sand-silt mixtures
GC	Clayey gravels; gravel-sand-clay mixtures
SW	Well graded sands; sand-gravel mixtures
SP	Poorly graded sands
SM	Silty sands; sand-silt mixtures
SC	Clayey sands; sand-clay mixtures
ML	Silts; silty, very fine sands; sandy or clayey silts
CL	Clays of low to medium plasticity; silty, sandy or gravelly clays
CH	Clays of high plasticity; fat clays
MH	Elastic silts; micaceous or diatomaceous silts
OL	Organic silts and organic silty clays of low plasticity
OH	Organic clays or silts of medium to high plasticity

#### BEDROCK SYMBOLS

B	Basalt	Sc	Schist
Gn	Gneiss	Sh	Shale
Gr	Granite	S:S	Siltstone
Ls	Limestone	Sl	Slate
Mo	Marble	Ss	Sandstone

#### SAMPLES

DS	Disturbed
US	Undisturbed

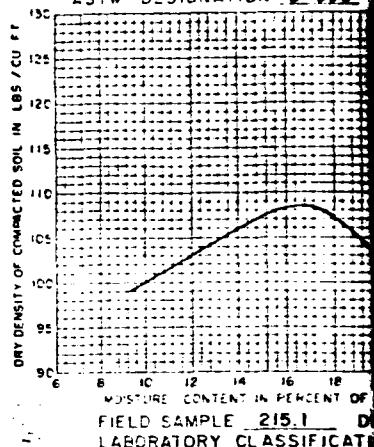
#### NOTE

All soil and rock classifications were determined by visual examination, except where otherwise noted.

### COMPACTED CU

LABORATORY SAMPLE NO.

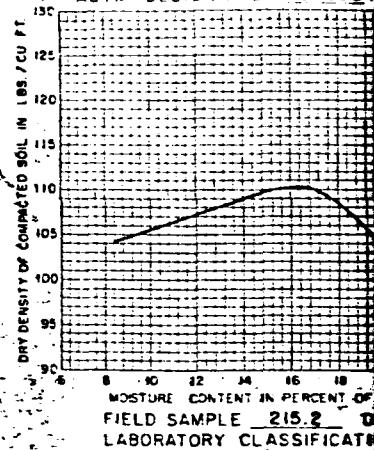
ASTM DESIGNATION D-698



### COMPACTED CU

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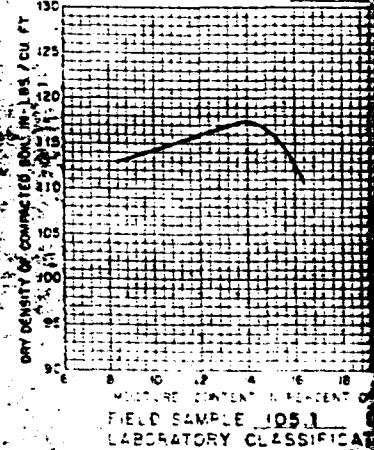
ASTM DESIGNATION D-698



### COMPACTED CU

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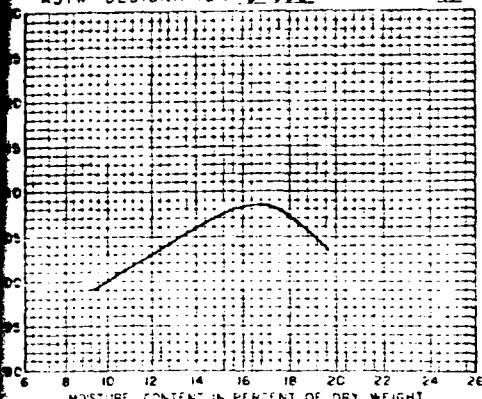
ASTM DESIGNATION D-698



### COMPACTION CURVE

LABORATORY SAMPLE NO 72W1254

ASTM DESIGNATION D-698 METHOD A

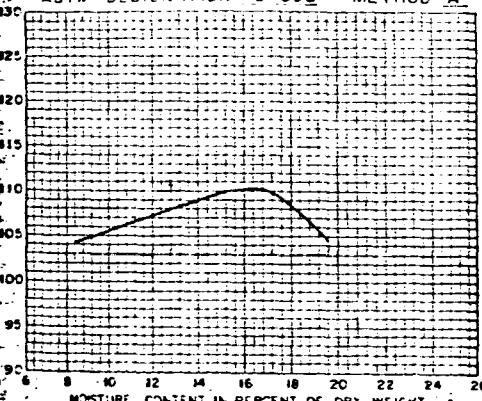


FIELD SAMPLE 215.1 DEPTH 10'-30'  
LABORATORY CLASSIFICATION CL

### COMPACTION CURVE

LABORATORY SAMPLE NO 72W1255

ASTM DESIGNATION D-698 METHOD A

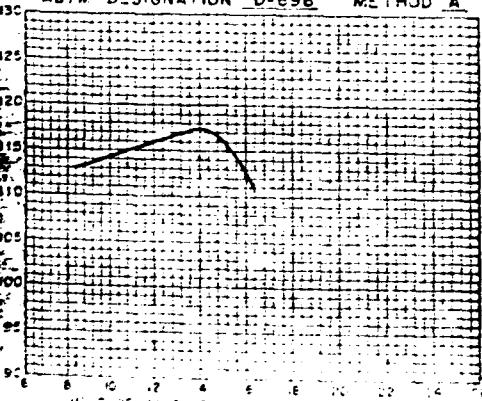


FIELD SAMPLE 215.2 DEPTH 10'-30'  
LABORATORY CLASSIFICATION SM

### COMPACTION CURVE

LABORATORY SAMPLE NO 72W1256

ASTM DESIGNATION D-698 METHOD A

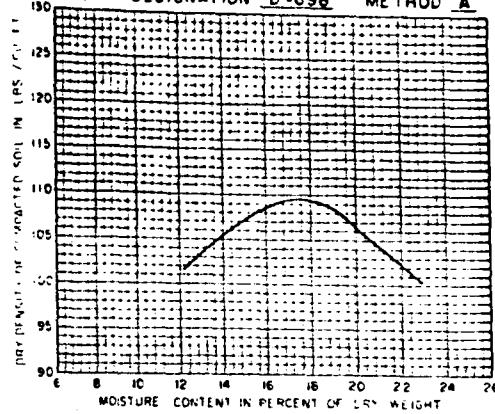


FIELD SAMPLE 215.1 DEPTH 30'-65'  
LABORATORY CLASSIFICATION SM

### COMPACTION CURVE

LABORATORY SAMPLE NO 72W1257

ASTM DESIGNATION D-698 METHOD A

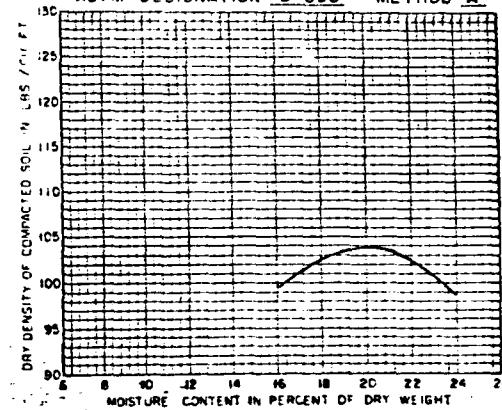


FIELD SAMPLE 106.1 DEPTH 0'-30'  
LABORATORY CLASSIFICATION ML

### COMPACTION CURVE

LABORATORY SAMPLE NO 72W1258

ASTM DESIGNATION D-698 METHOD A



FIELD SAMPLE 116.1 DEPTH 0'-25'  
LABORATORY CLASSIFICATION ML

2

BRANDYWINE CREEK WATERSHED

FLOODWATER RETARDING DAM PA-433  
CHESTER COUNTY, PENNSYLVANIA

COMPACTION DATA

U. S. DEPARTMENT OF AGRICULTURE  
SOIL CONSERVATION SERVICE

PLATE 13

CRISP 10-72

PA-433-P

**APPENDIX**

**F**

SITE GEOLOGY  
BEAVER CREEK DAM  
(SCS PA 433)

Beaver Creek Dam is located in the Piedmont Uplands Section of the Piedmont Physiographic Province. As shown on Plate F-1, the area surrounding the dam consists predominantly of a granite like rock called granodiorite (referred to as quartz monzonite in the files of the Department of Environmental Resources in Harrisburg). Throughout the area, minor amounts of pegmatite and metadiabase occur as dikes. No bedrock exposures were observed during the field inspection, but the original geology report describes steeply dipping "flow structures" in the weathered bedrock and saprolite, encountered during the Soil Conservation Service site investigation. Granodiorite is a dense igneous rock usually having variable thickness of weathered or decomposed surficial material above the sound bedrock. Several regional east-northeasterly striking thrust faults occur in the area, one being about 1,200 feet to the north and the other about 1,000 feet to the south of the right abutment.

